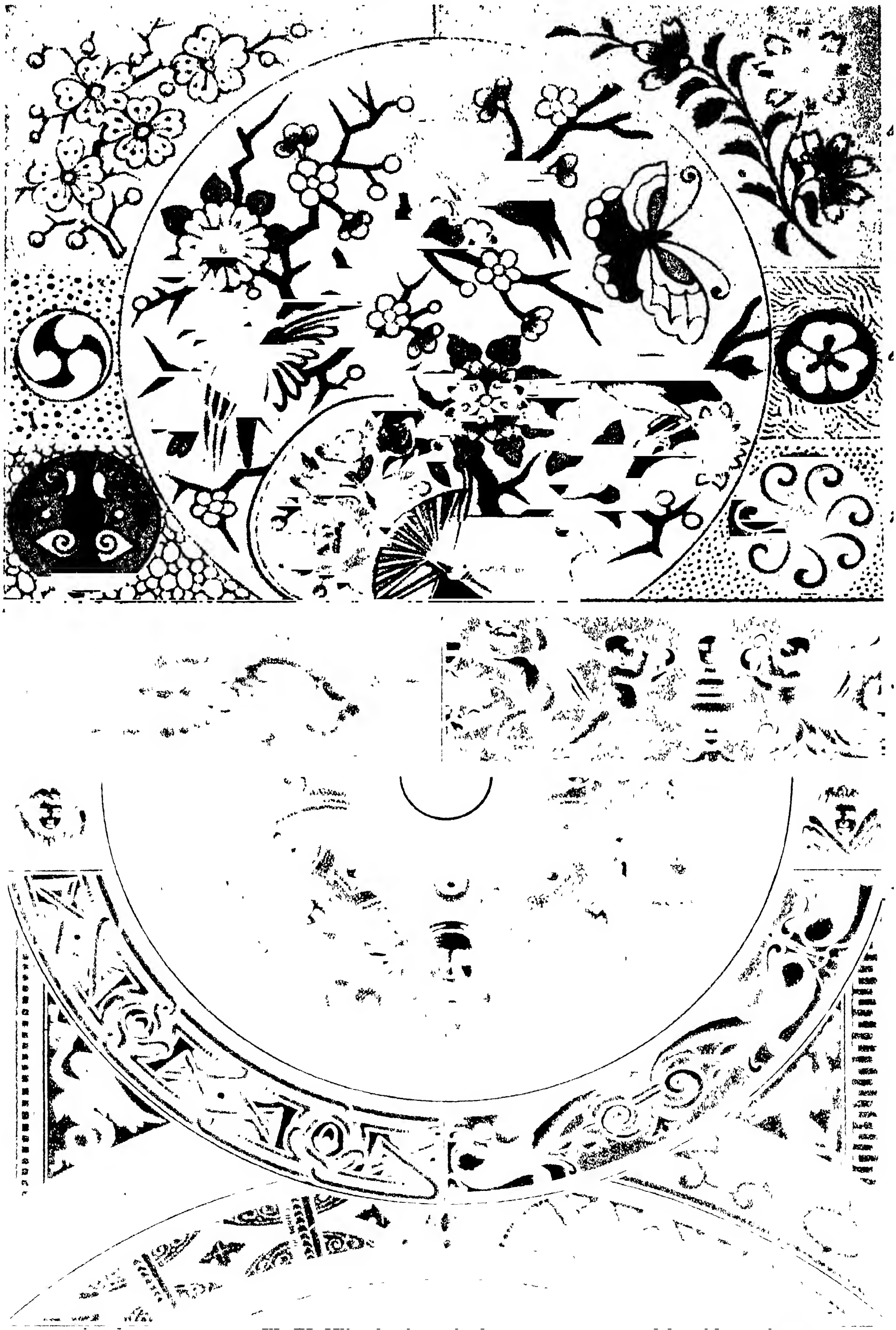
ENAMEL.

CLOISONNÉ | LIMOGES.



13 14

The NATIONAL ENCYCLOPÆDIA

A DICTIONARY OF UNIVERSAL KNOWLEDGE.

BY

WRITERS OF EMINENCE IN

LITERATURE, SCIENCE, AND ART.

VOLUME V.

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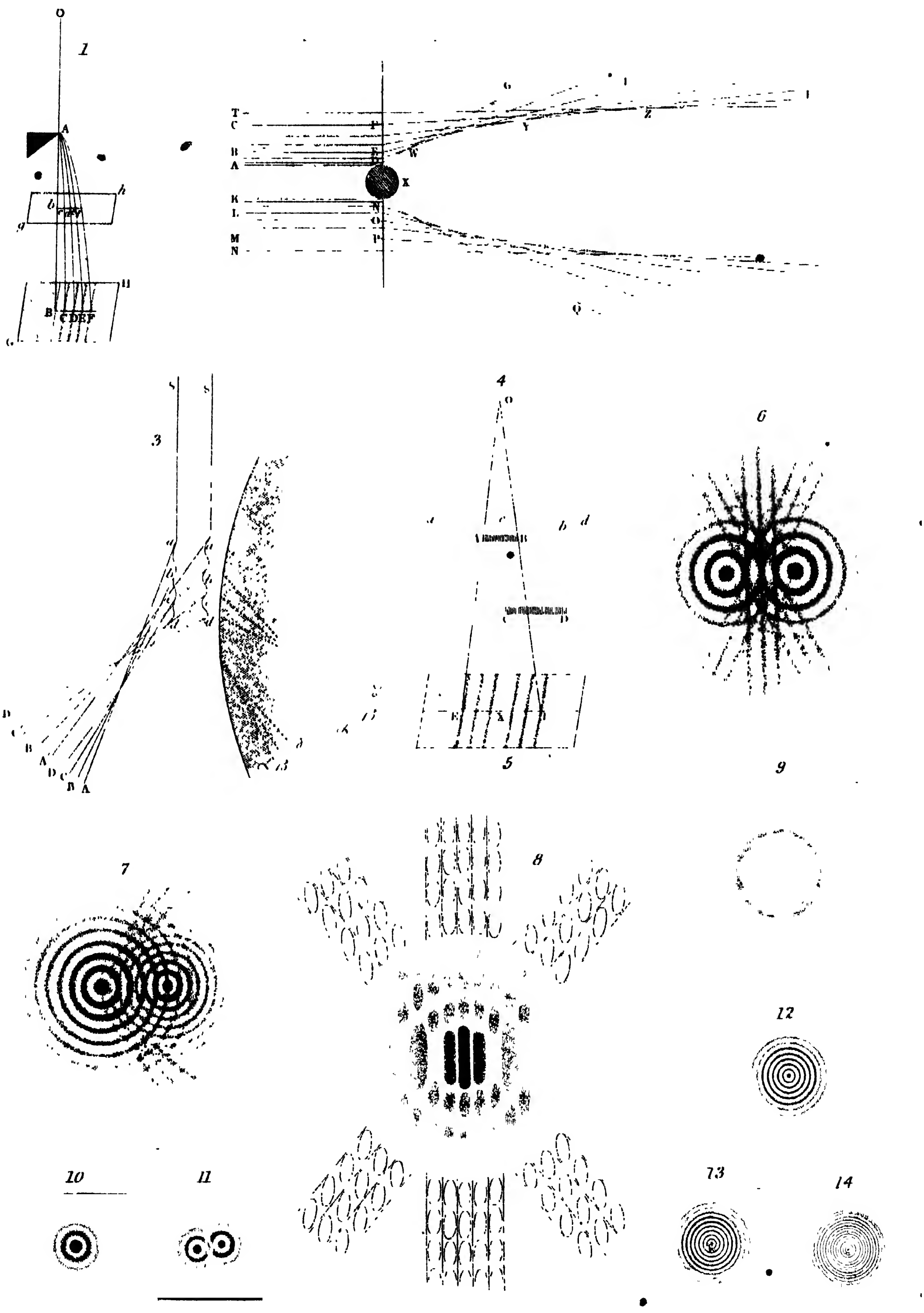
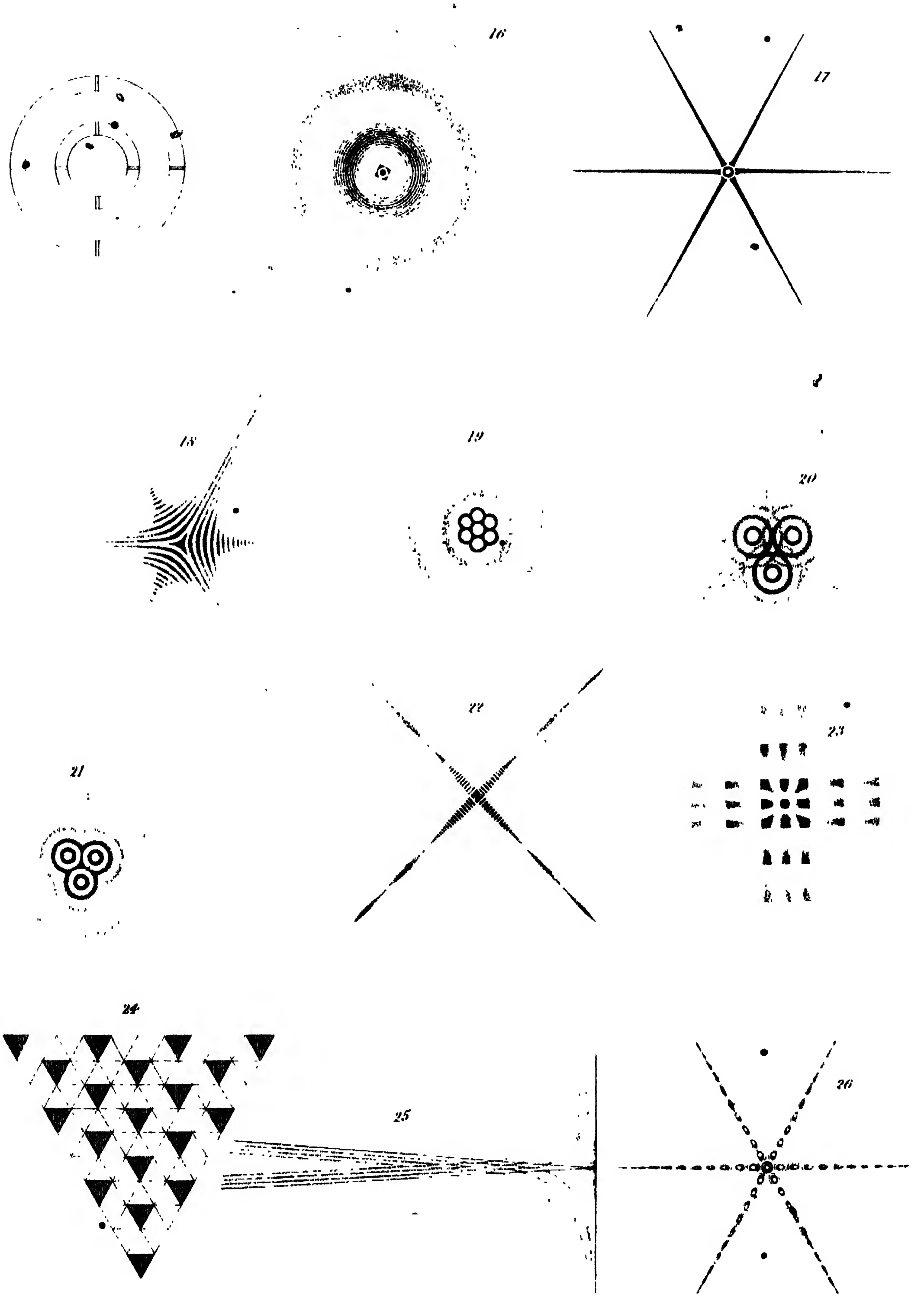
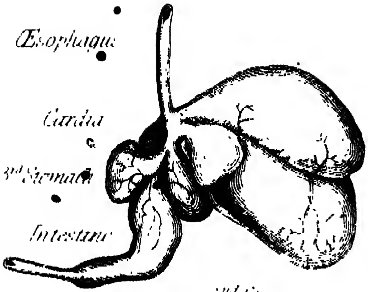
DIFFRACTION OF LIGHT.



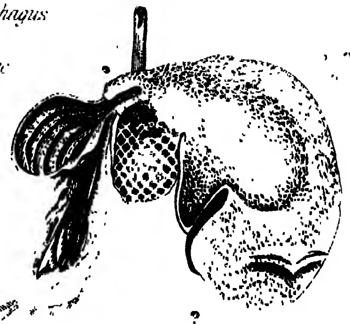
DIFFRACTION OF LIGHT.



DIGESTION.



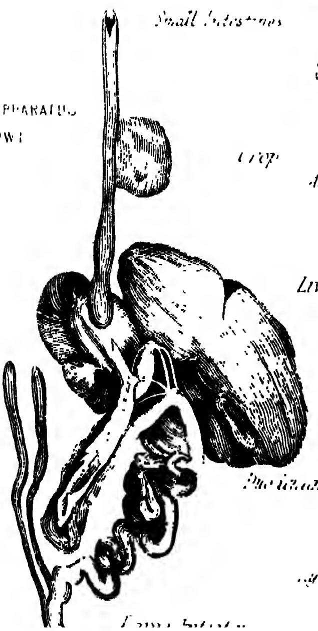
STOMACH OF A SHEEP

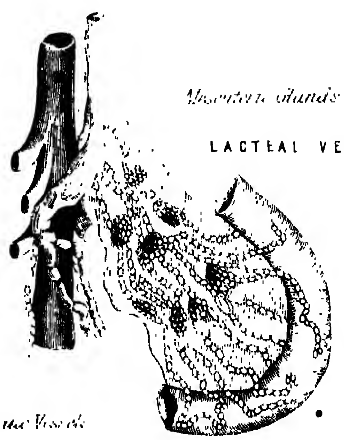


SECTION OF A SHEEP'S STOMACH

STOMACH, LIVER AND INTESTINAL CANAL OF MAN.

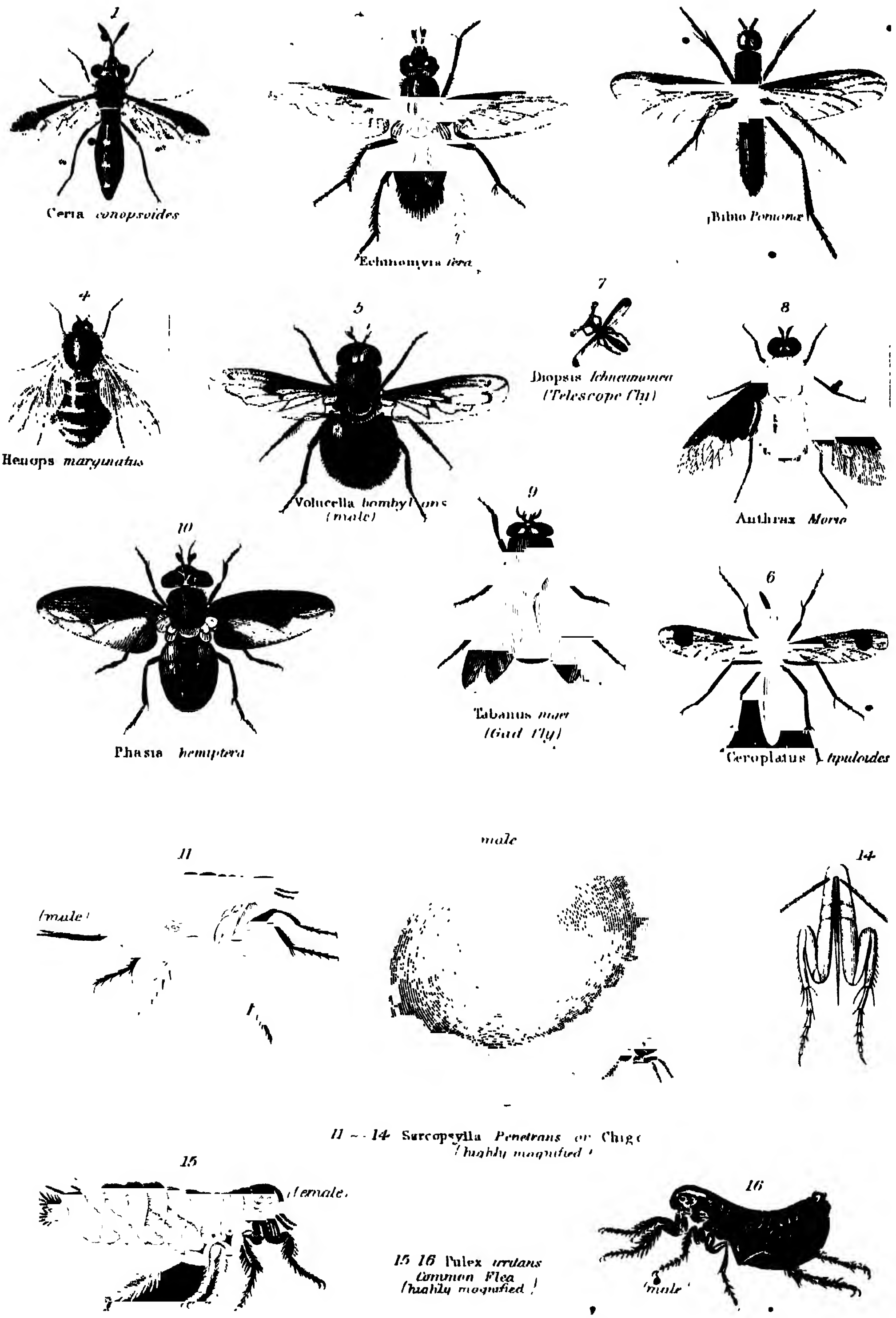
DIGESTIVE APPARATUS OF A FOWL





LACTEAL VESSELS.

PTERA.



Ceria *conopsoides*

Echinomyia *fera*

Bibio *Pomonae*

Henops *marginatus*

Volucella *bombylans* (*male*)

Diopsis *Ichneumonea* (*Telescope Fly*)

Anthrax *Morio*

Phasia *hemiptera*

Tabanus *niger* (*Gad Fly*)

Ceroplatus *tipuloides*

11 – 14 Sarcopsylla *Penetrans* or Chigoe (*highly magnified*)

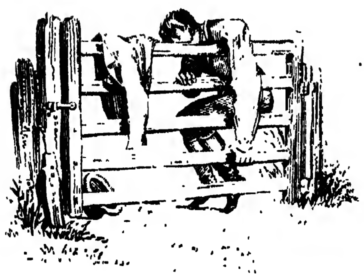
15 16 Pulex *irritans* *Common Flea* (*highly magnified*)

I S L O C A T I

1

2

Dislocations of the shoulder.



3

Reduction of dislocated shoulder

4

Dislocation of Elbow-joint

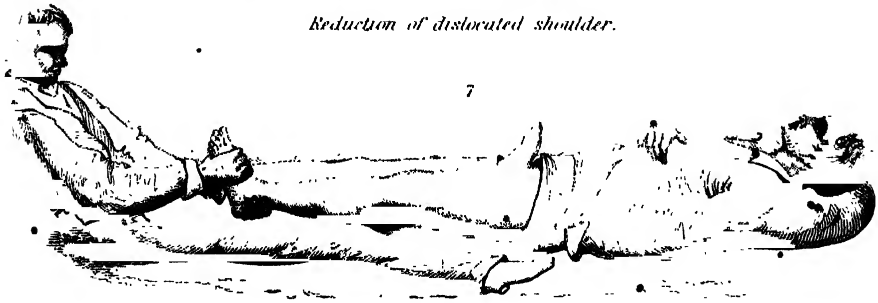
5

Dislocation of jaw

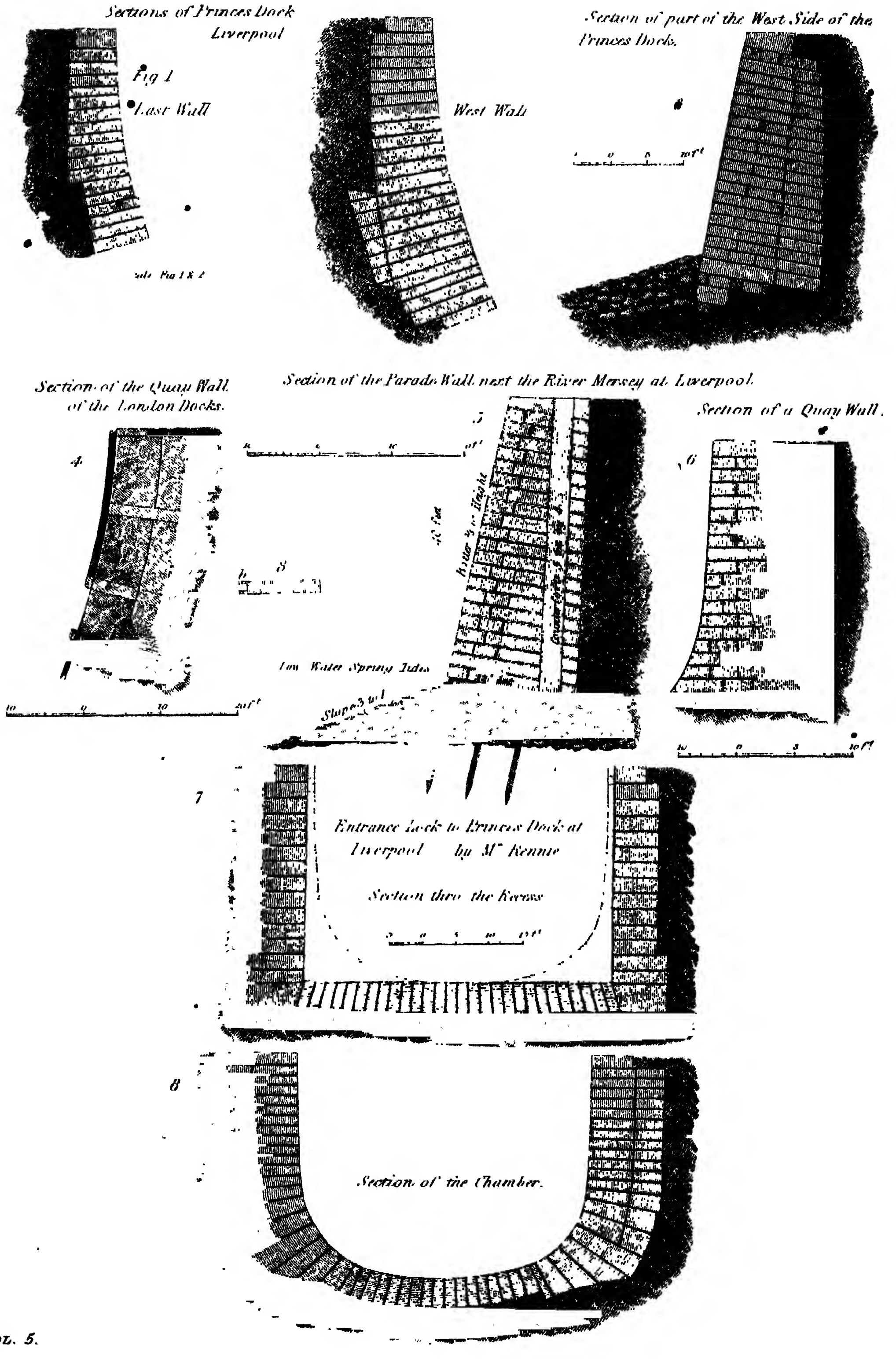
6

Reduction of dislocated shoulder.

7



Reduction of dislocated hip-joint


Sections of Princes Dock Liverpool
Fig 1
East Wall
West Wall
Section of part of the West Side of the Princes Docks.
Section of the Quay Wall of the London Docks.
4
Section of the Parade Wall next the River Mersey at Liverpool.
5
Section of a Quay Wall.
6
Low Water Spring Tides
7
Entrance Lock to Princes Dock at Liverpool by Mr Rennie
Section thro the Recess
8
Section of the Chamber.

Figs. 9-11. Graving Dock at Birkenhead

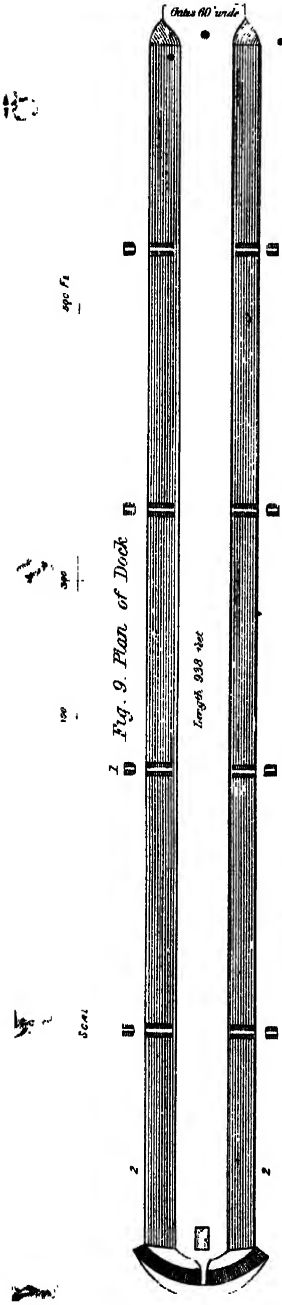


Fig. 9. Plan of Dock

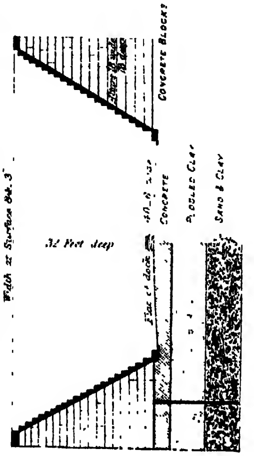


Fig 10. Section at 1
Width at Surface 84.3'

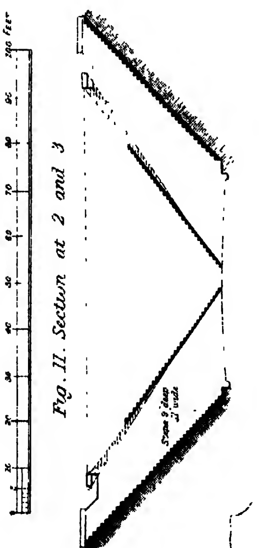


Fig. 11. Section at 2 and 3

Figs 12-14. Hauling Machinery at Ayr Slipway.

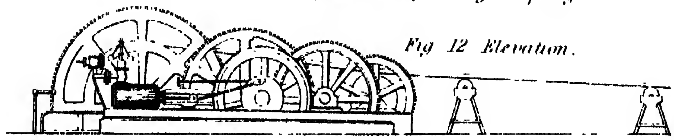


Fig 12 Elevation.

Fig. 14 Details

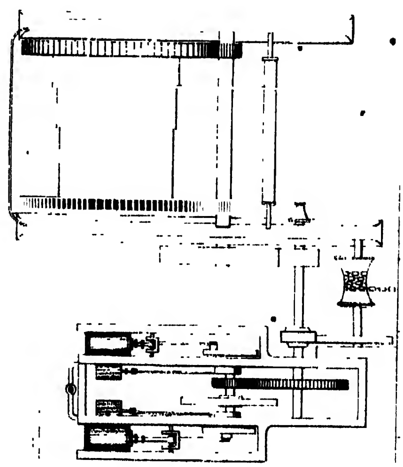
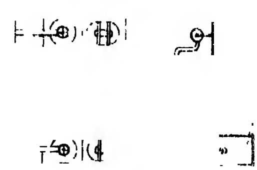
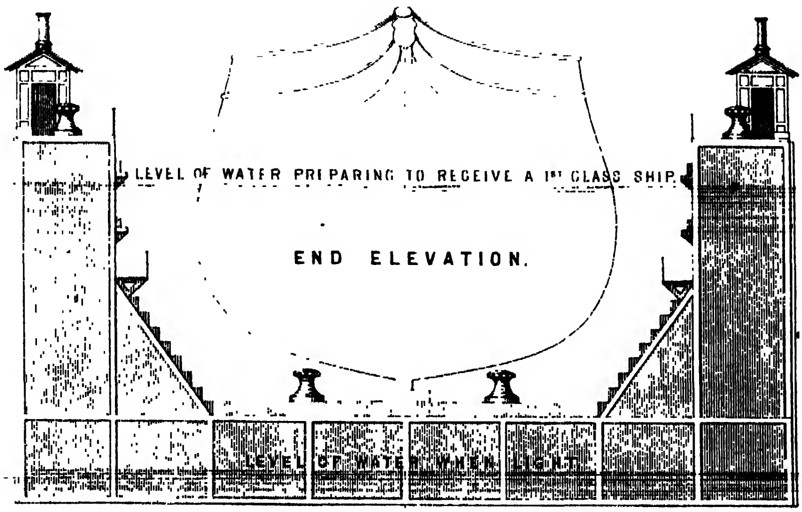


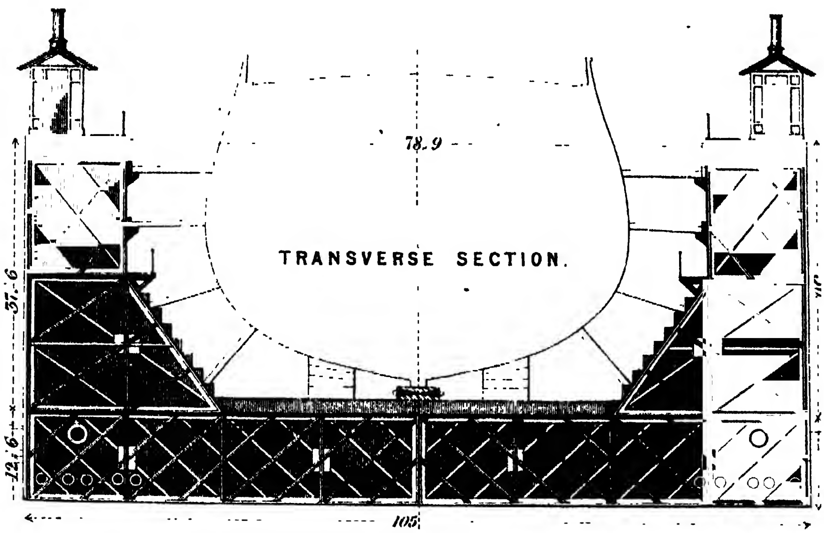
Fig 13 General Plan



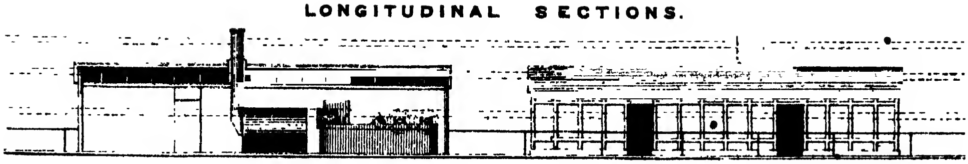
C K

IRON FLOATING DOCK.





LONGITUDINAL SECTIONS.



The Barrow Depositing Dock.

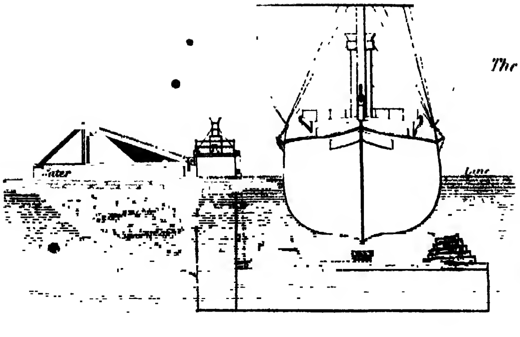


Fig. 18.

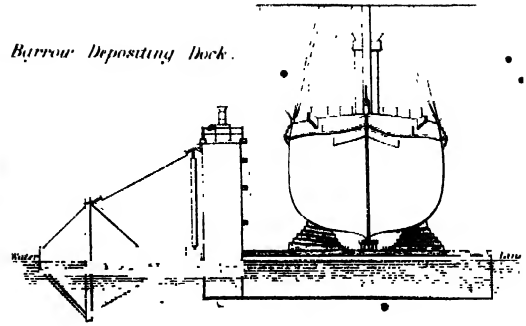


Fig. 19.

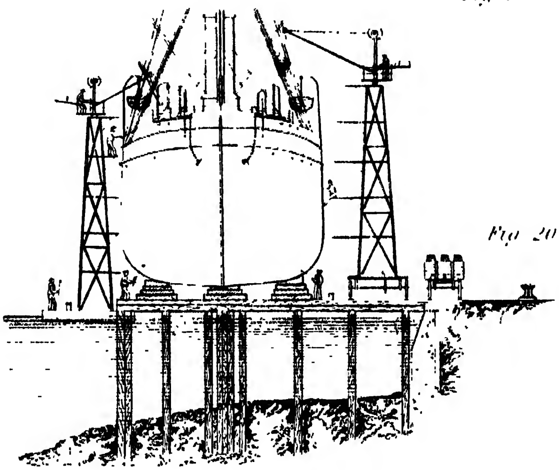


Fig. 20

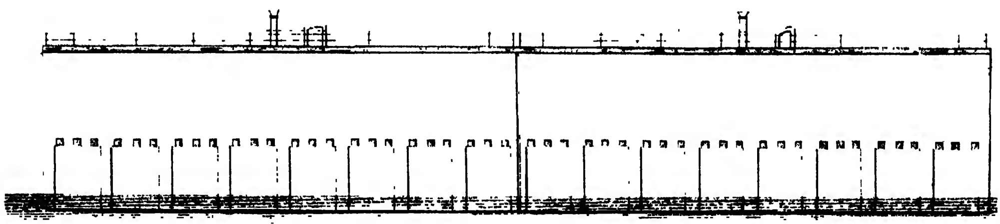


Fig. 21

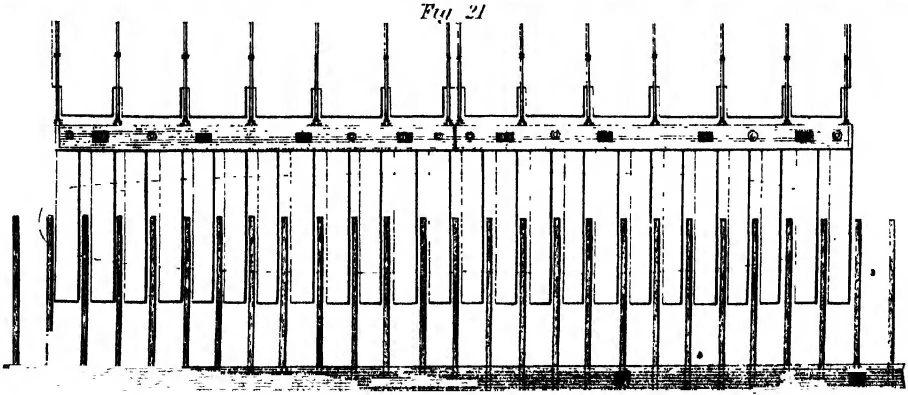
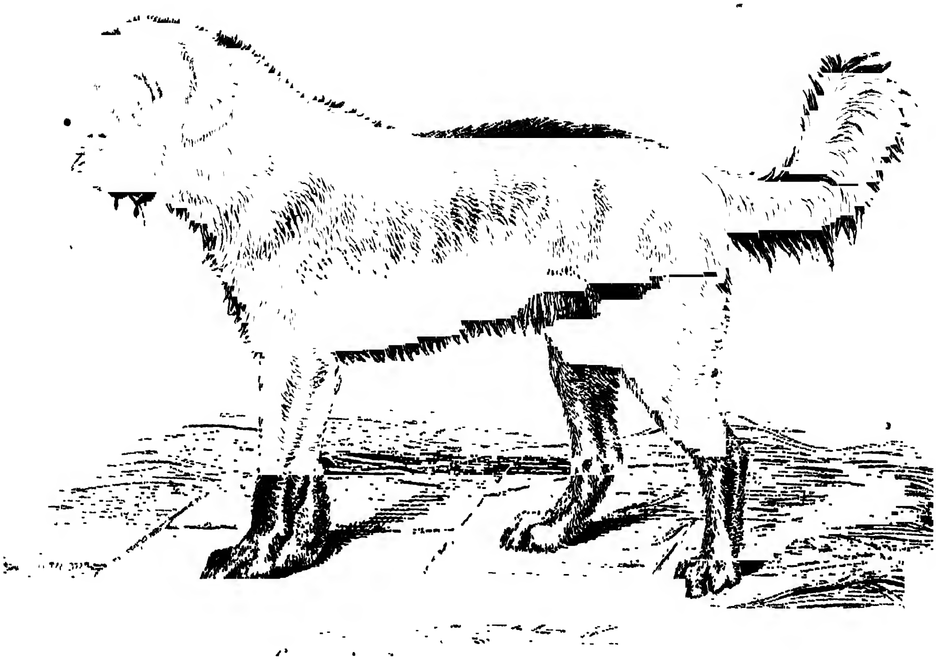
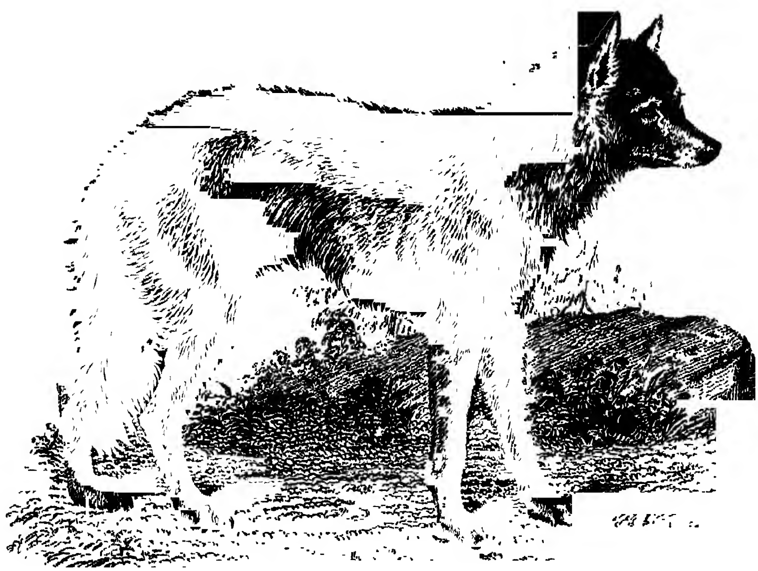


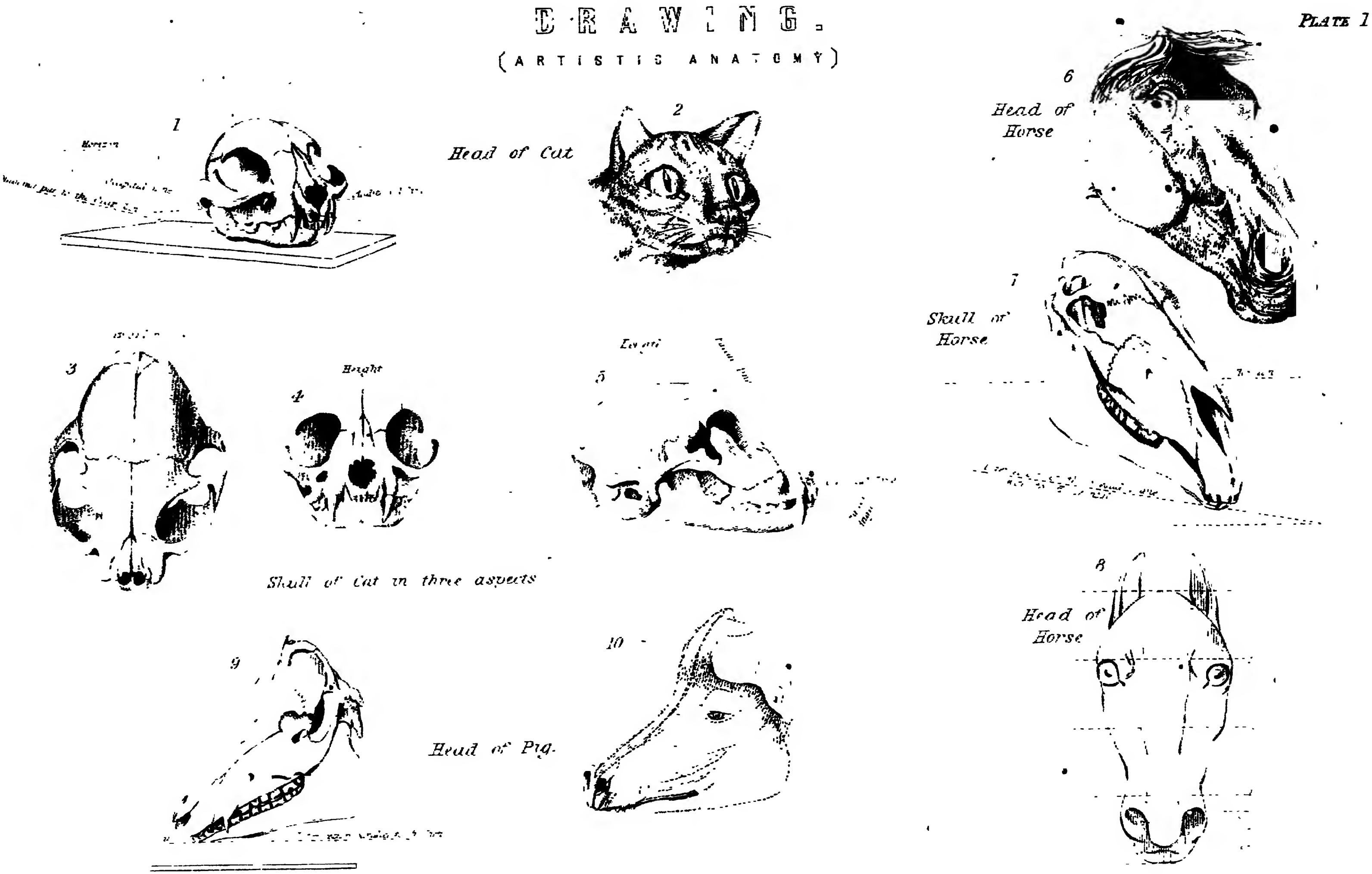
Fig. 22





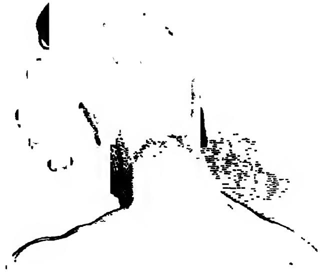
DRAWING.

(ARTISTIC ANATOMY)



DRAWING.

(CONTOURS OF THE HEAD)



7. Female Head and Neck.

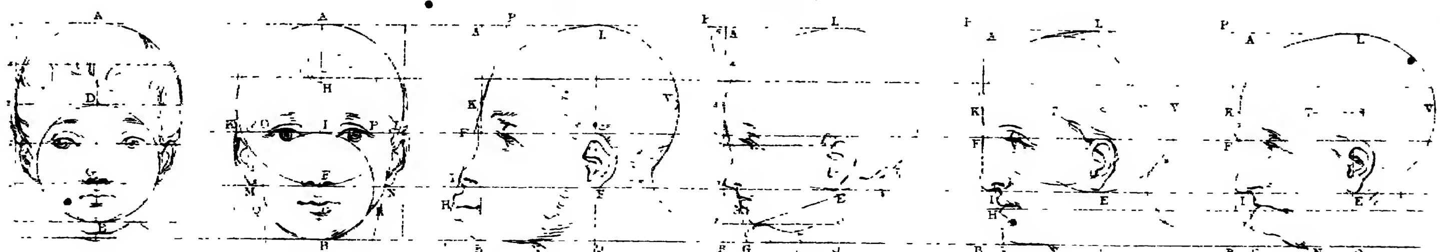
9. Movements of the Head

11

10

Planes of the Human Skull

8. Male Head and Neck.



Prognathous

Orthognathous

1 Infancy

2. Youth

3 Negro

4 Infancy

5. Youth

6 Age

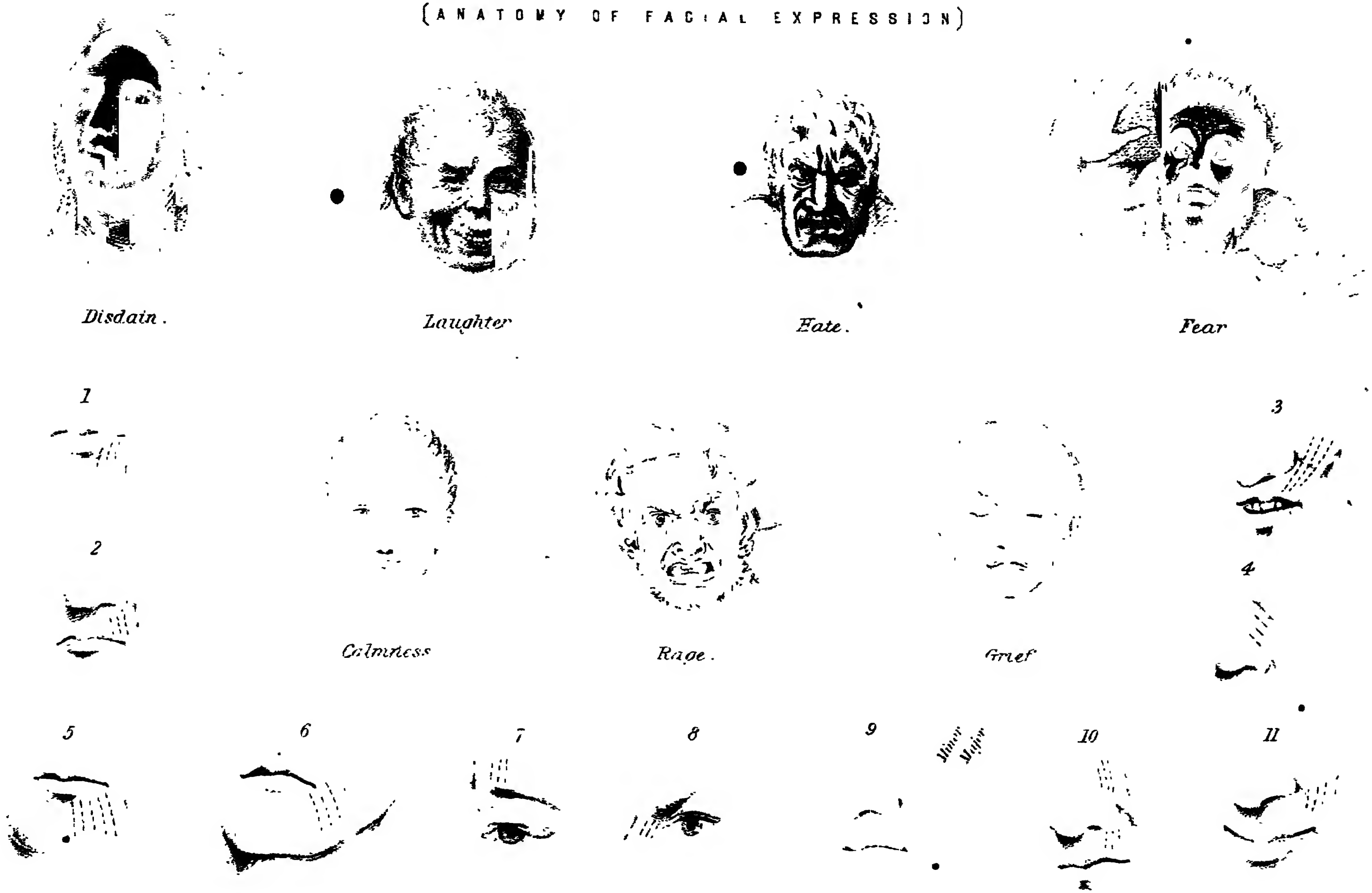
FULL FACE

PROFILE

PLATE.

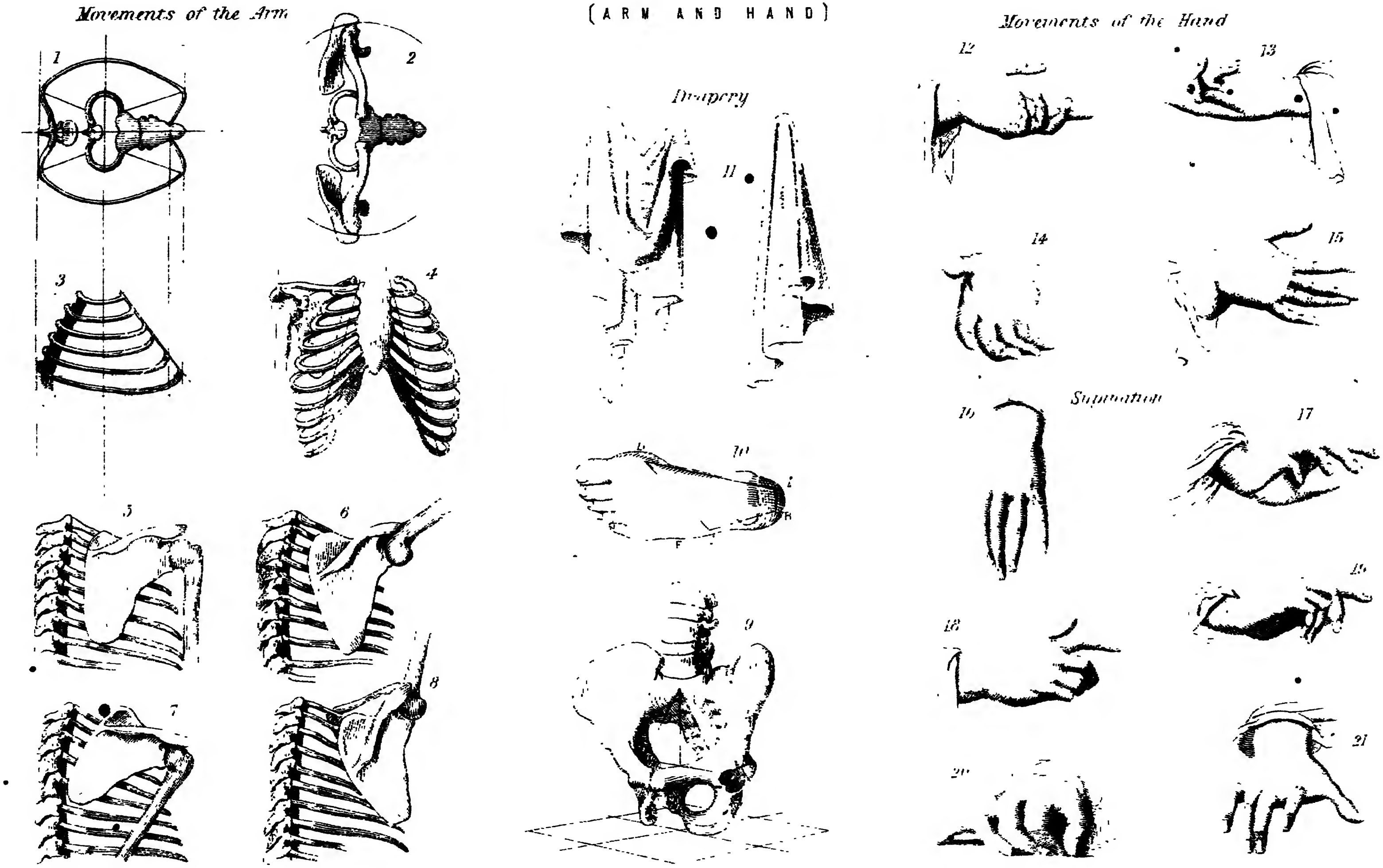
DRAWING.

(ANATOMY OF FACIAL EXPRESSION)



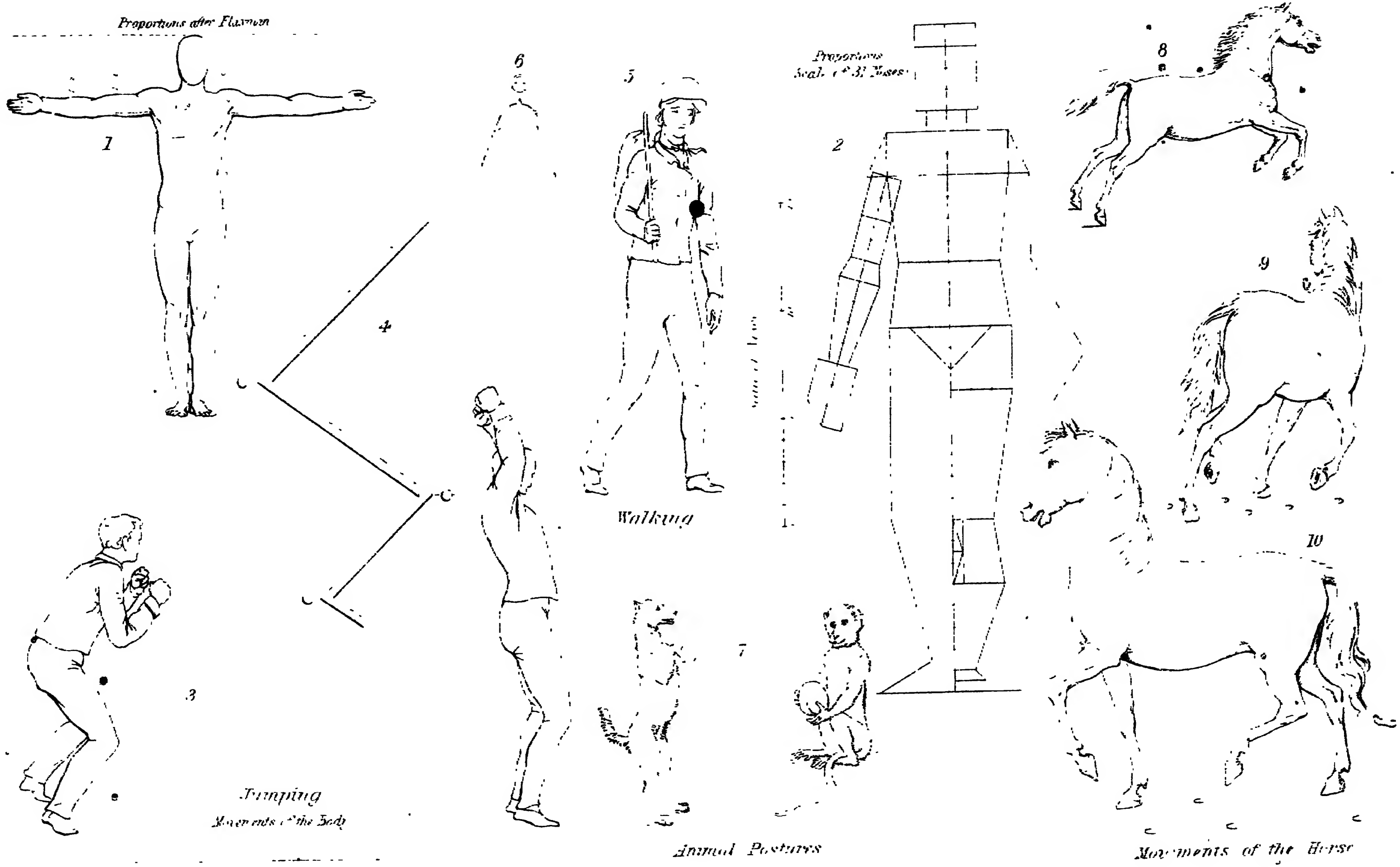
DRAWING.

(ARM AND HAND)

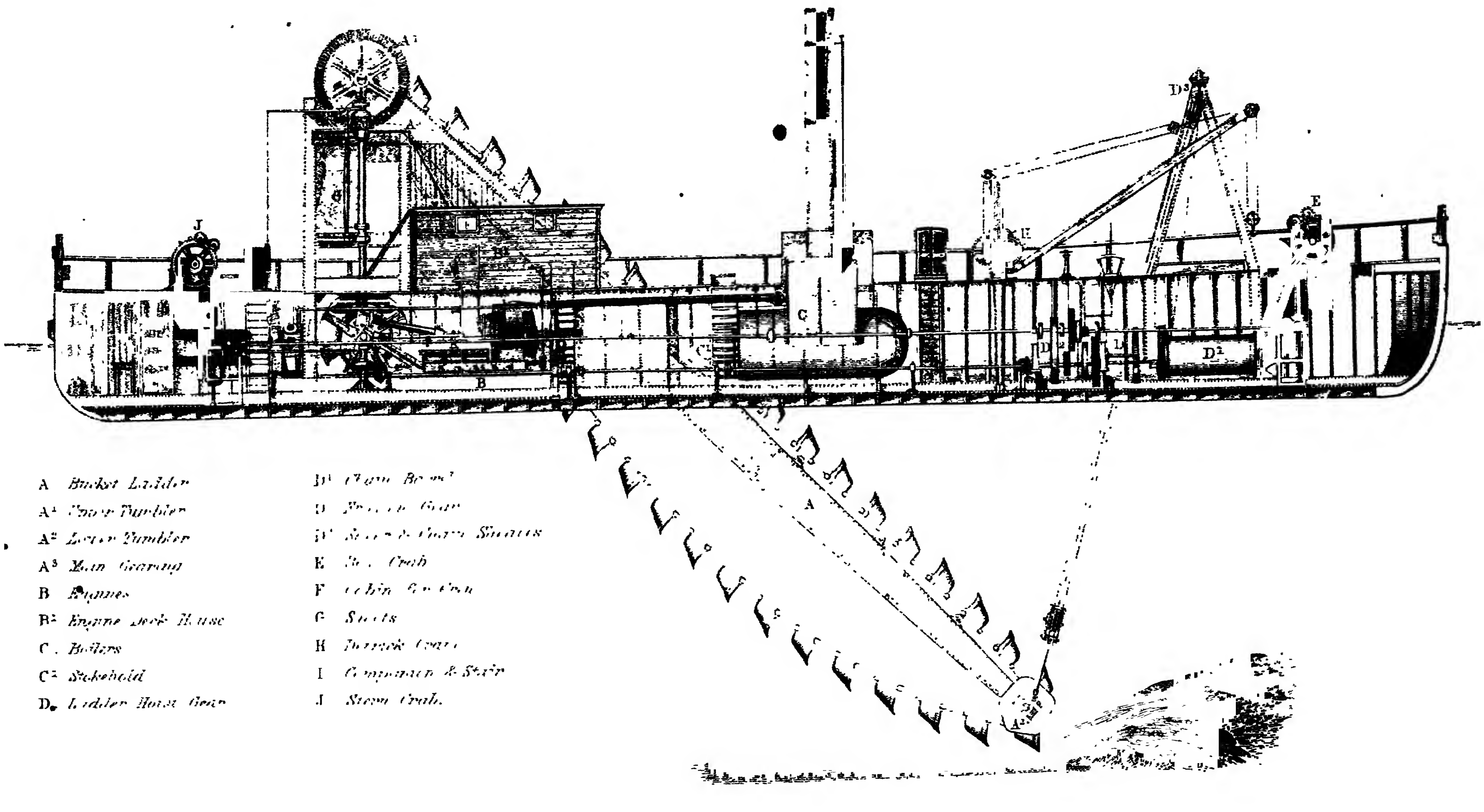


DRAWING.

PLATE 5.



(STEAM DREDGER)



A Bucket Ladder
A1 Upper Tumbler
A2 Lower Tumbler
A3 Main Gearing
B Engines
B1 Engine Deck House
C Boilers
C1 Stokehold
D Ladder Hoist Gear
D1 Chain Boom
D2 Mooring Gear
D3 Shears & Chain Sheaves
E Side Crab
F [illegible]
G Spouts
H Derrick Crane
I Companion & Stair
J Stern Crab.

2

Muscles of the Pinna

1

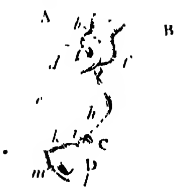
Pinna, or external ear

3

Muscles of the Pinna

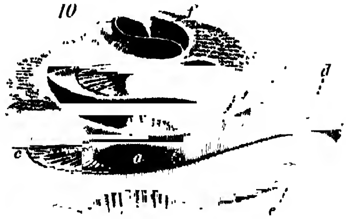
4-7 Bony Labyrinth or internal ear

8



Bones of the middle ear

10



Cochlea.

9

Bones of the middle ear.

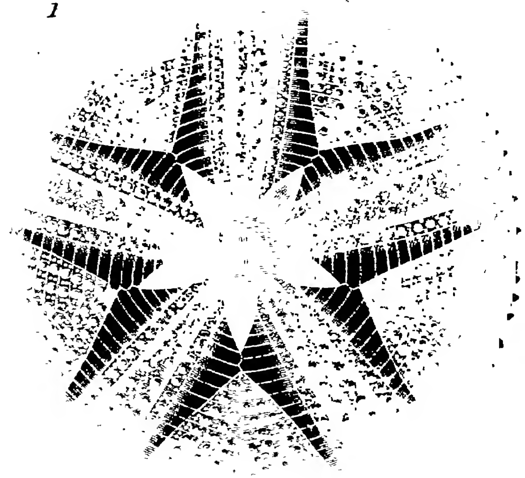
11

General view of ear

ECHINOIDEA.

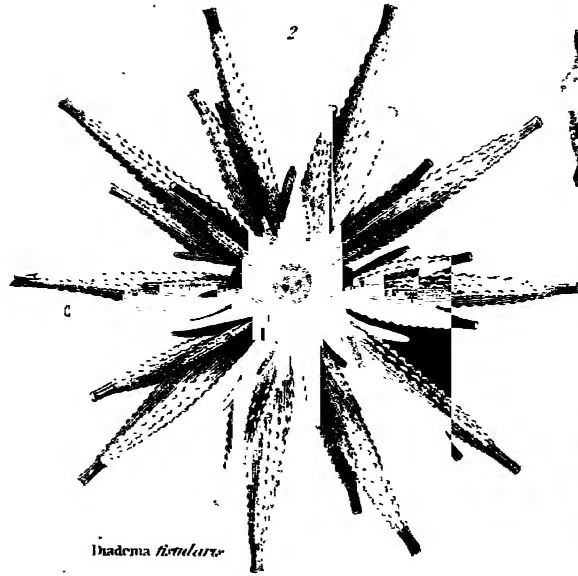
(ORDER ENDOCYCLICA)

1



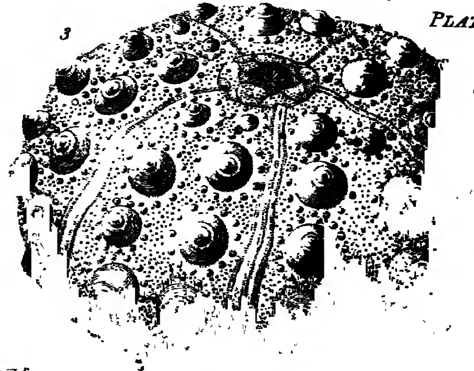
3 Astropyga *radiata*

2

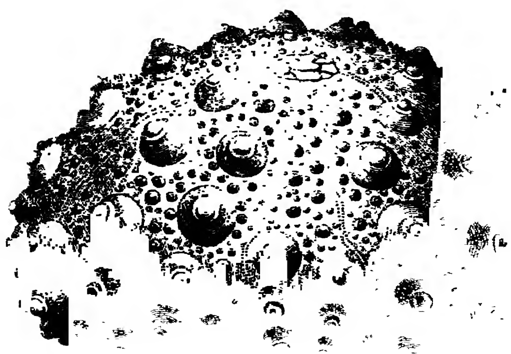


Diadema *fistularis*

3

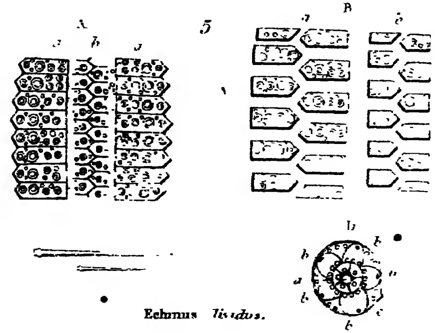


Cidaris *imperialis*



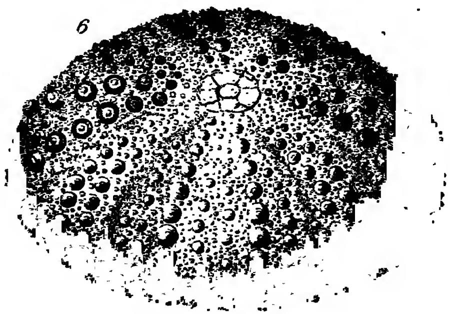
Echinometra *mammillatus*

5



Echinus *lividus*.

6



Echinus *miliaris*

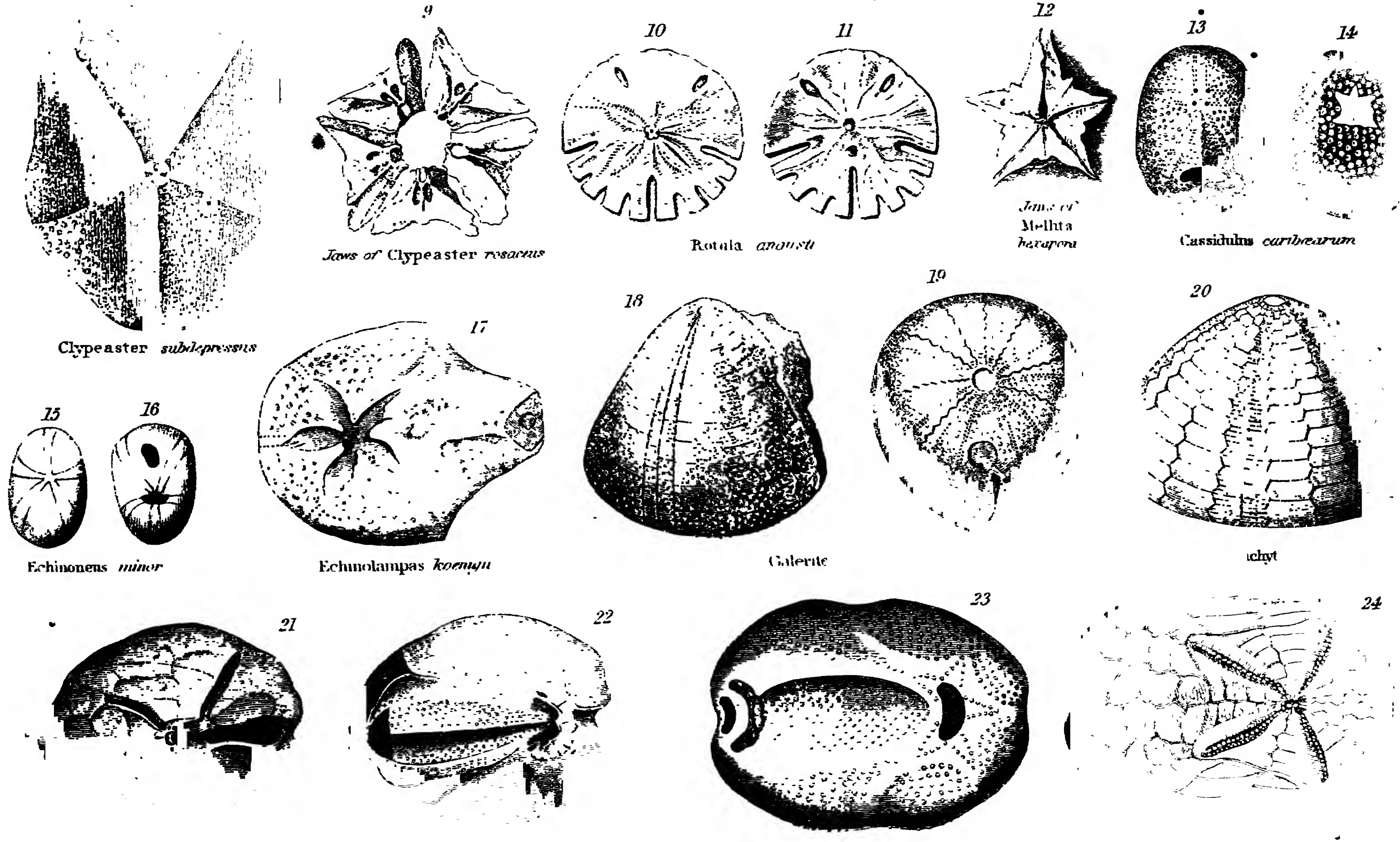
7

Echinus *elegans*

E G   E

R E   YCLICA)

PLATE



9 Jaws of Clypeaster rosaceus

10, 11 Rotula augusti

12 Jaws of Mellita hexapora

13, 14 Cassidulus caribaearum

Clypeaster subdepressus

15, 16 Echinoneus minor

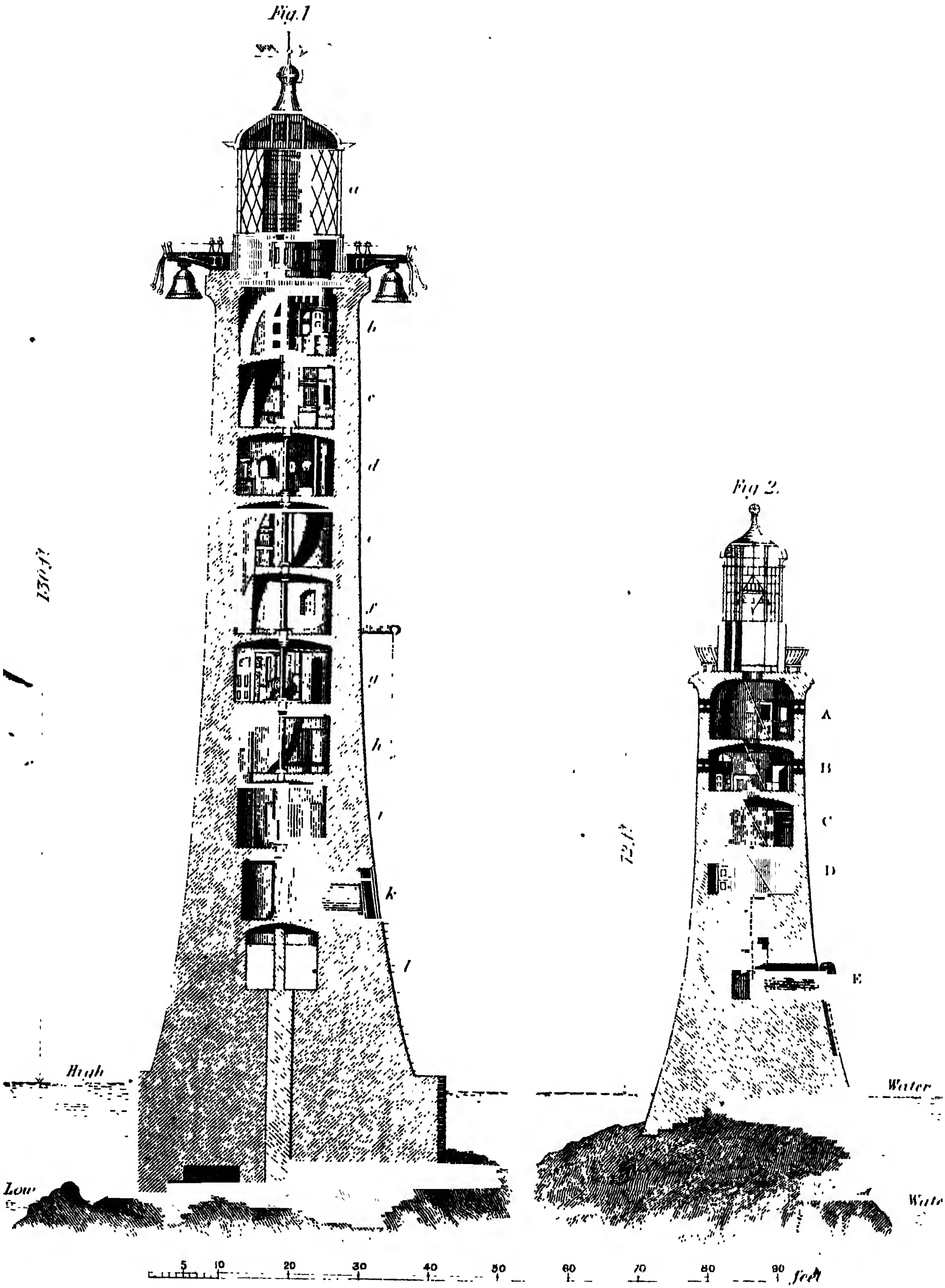
17 Echinolampas koenigii

18, 19 Galerite

20 ichyt

21, 22 Schizaster atropos

23, 24 Brissus ventricosus



Section of new Lighthouse 1882

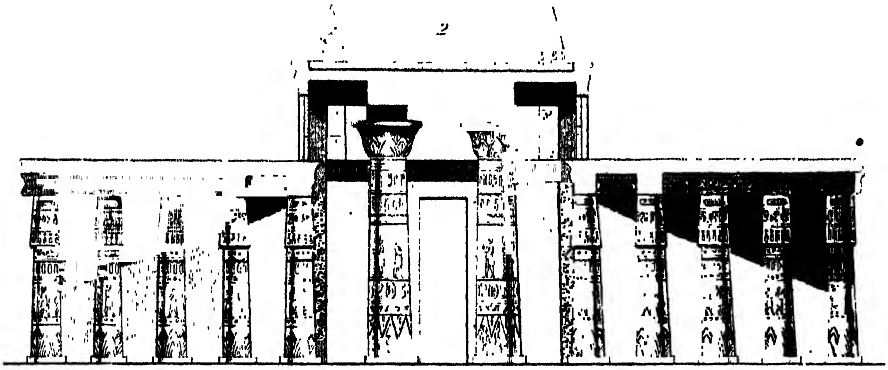
Section of old Lighthouse 1759.

EGYPTIAN ARCHITECTURE

1

View and Plan of the Temple at Edfu

2

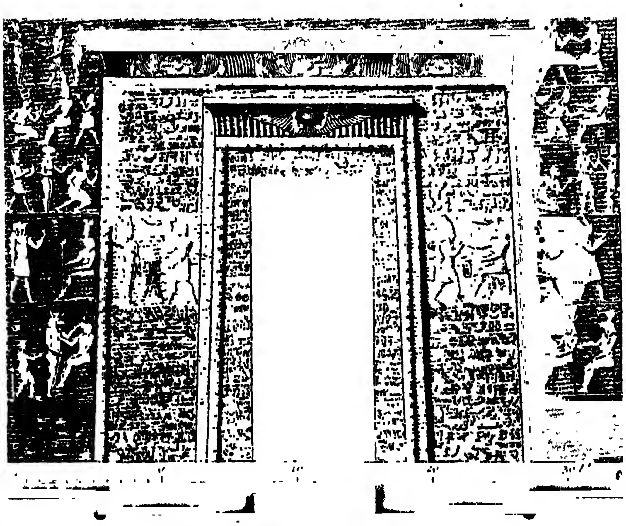


Section of the Hall of the Palace at Karnak

3

Column at Denderah with Isis Capital.

4



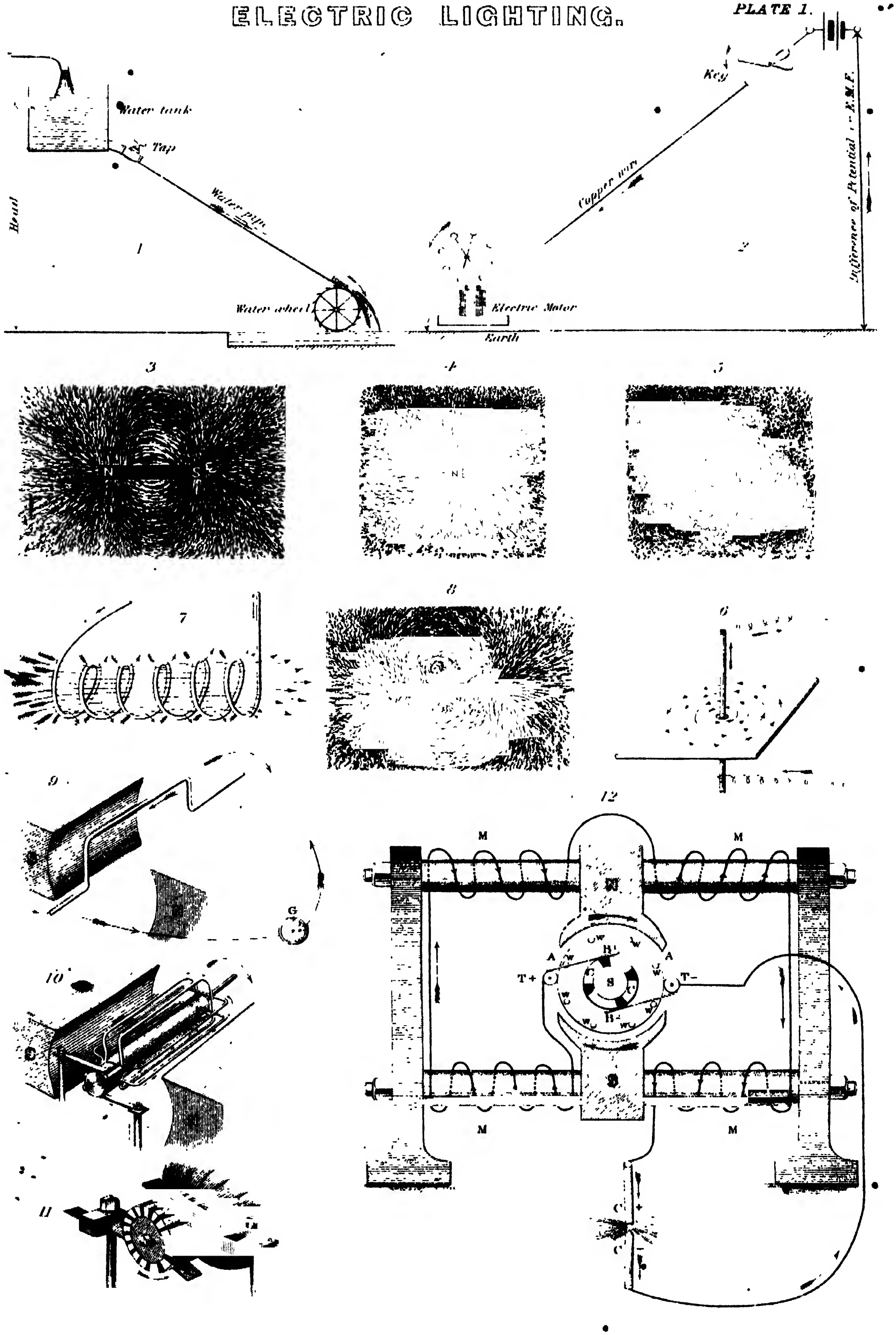
Doorway in the Temple at Denderah.

5

Column at Edfu with Lotus flower Capital.

ELECTRIC LIGHTING.

PLATE 1.



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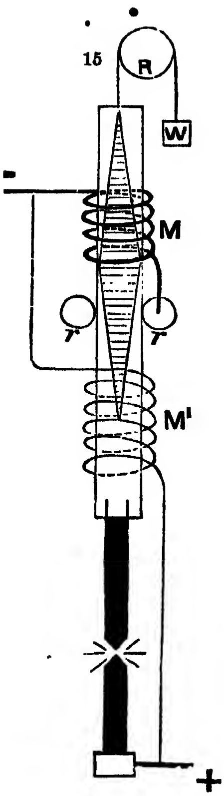

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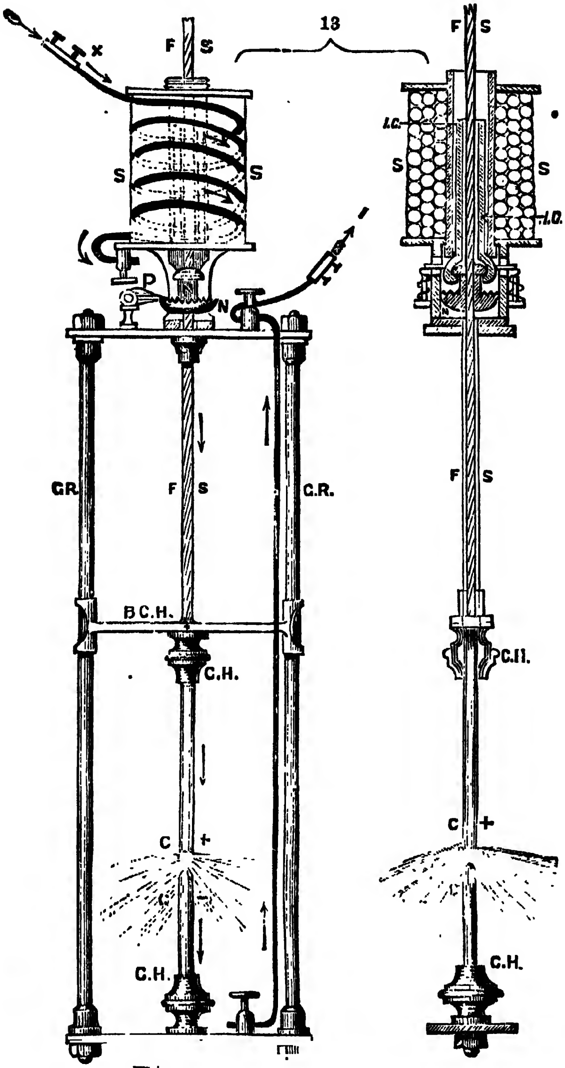

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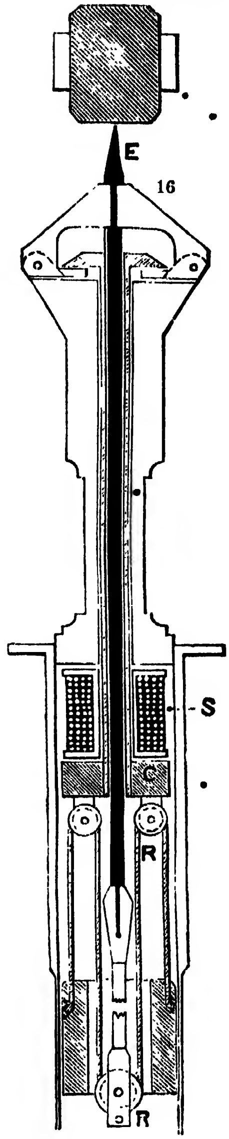

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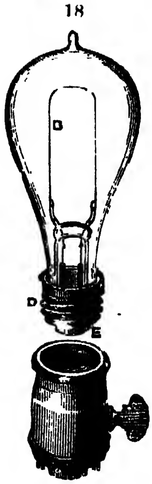

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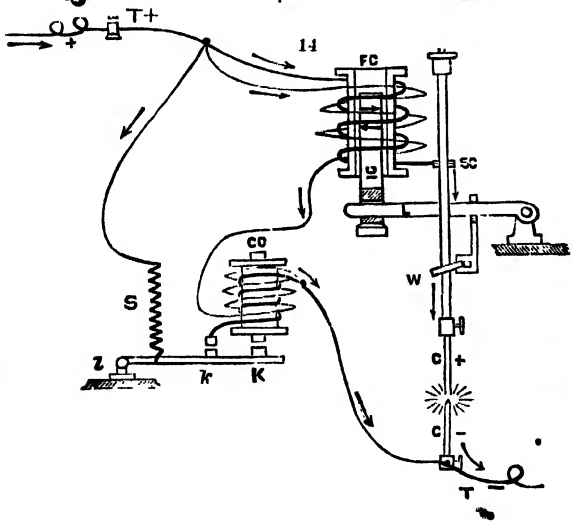

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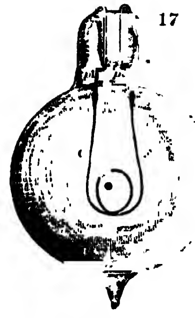

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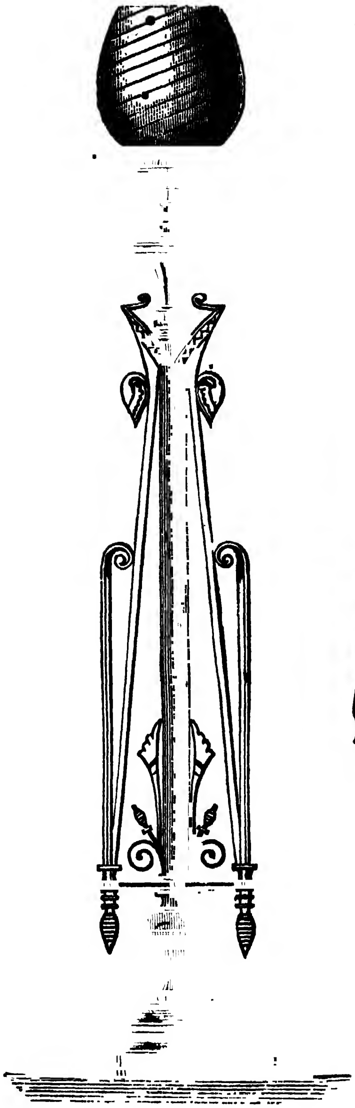

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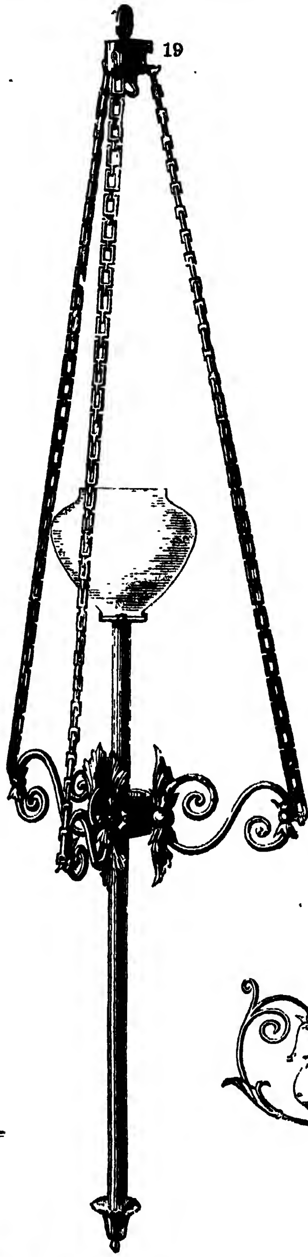

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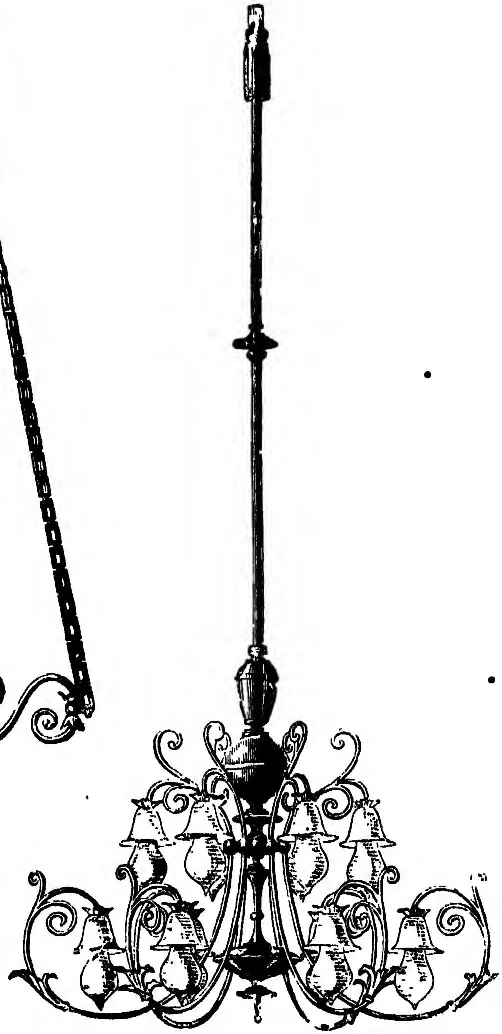

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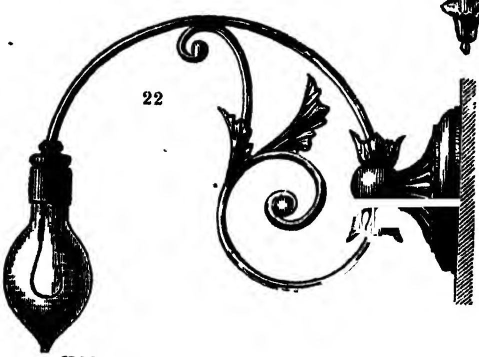

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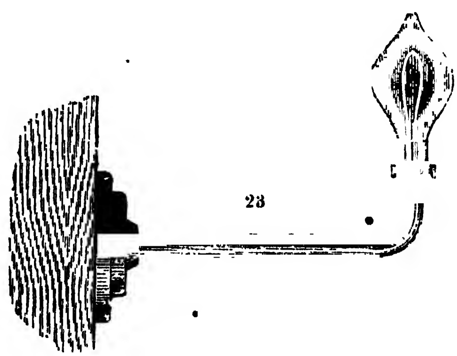

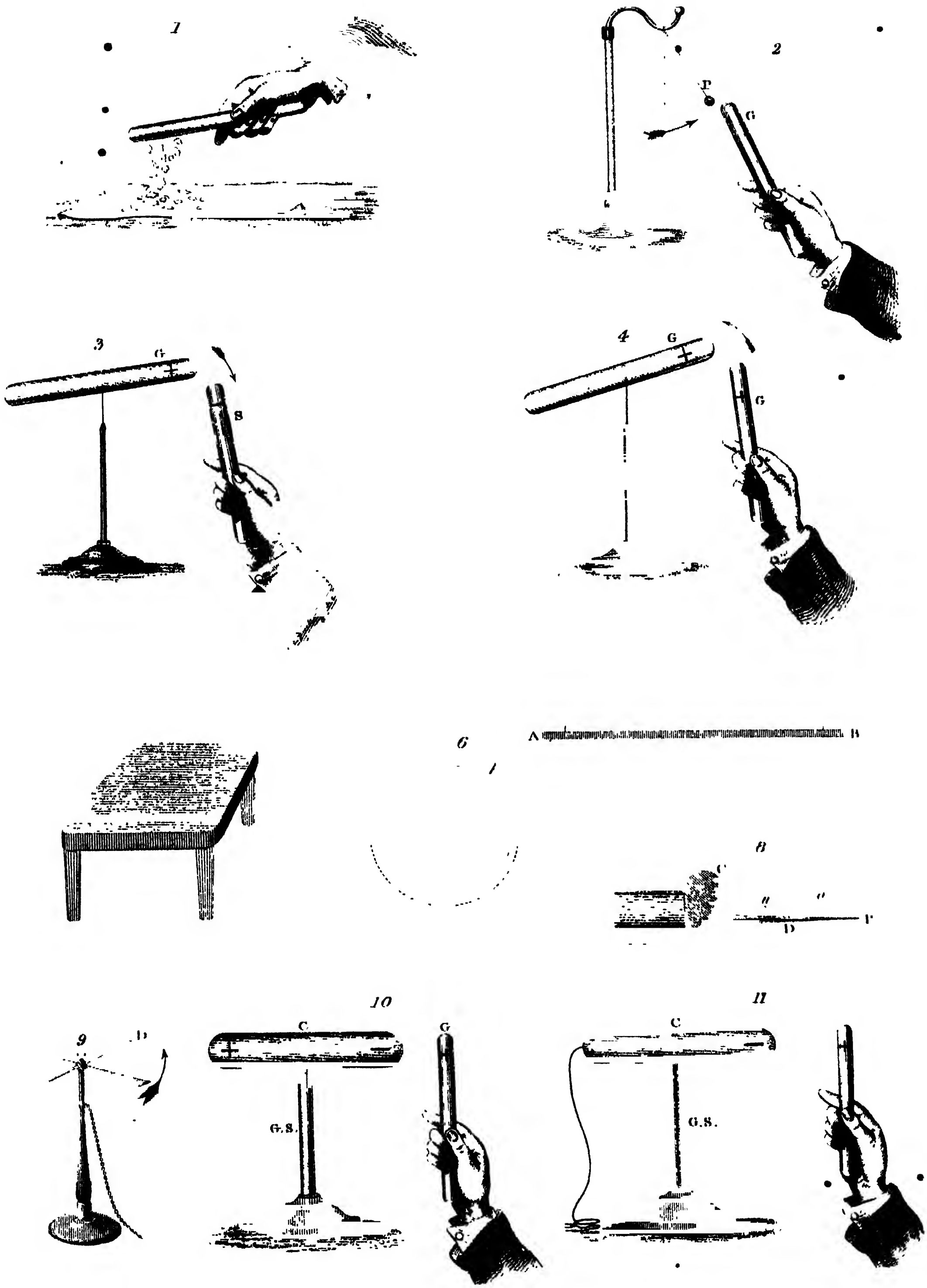
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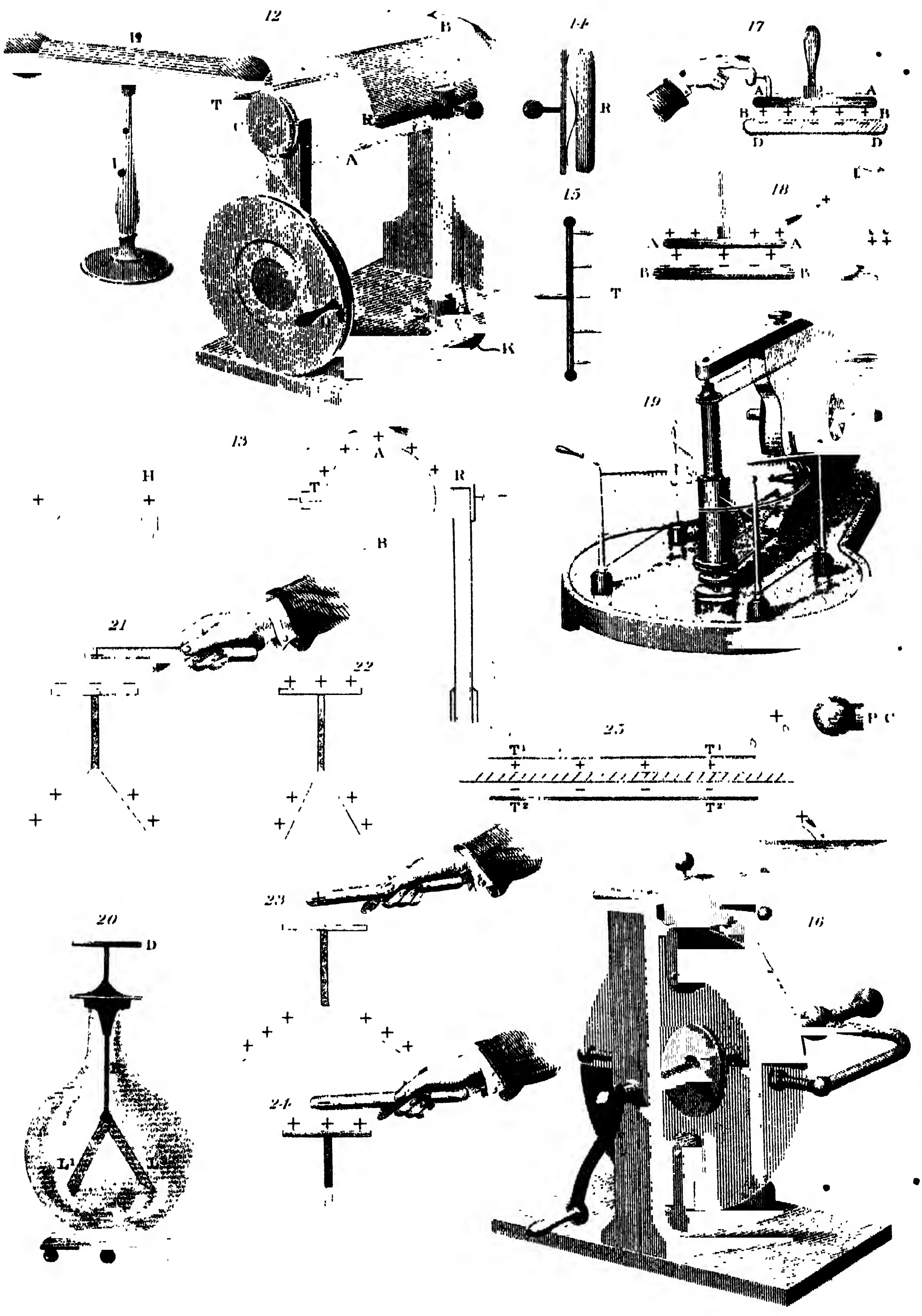
G.S.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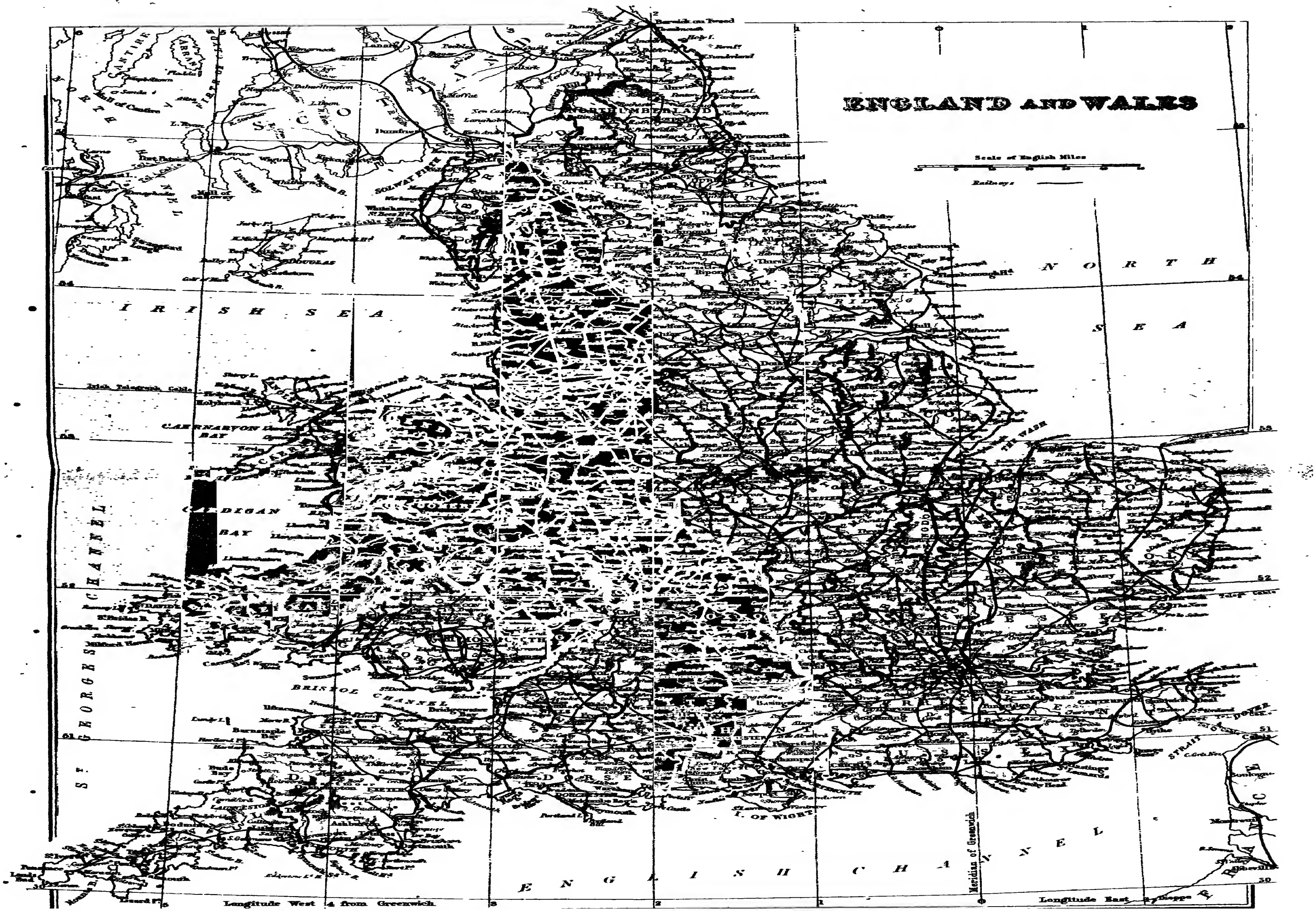
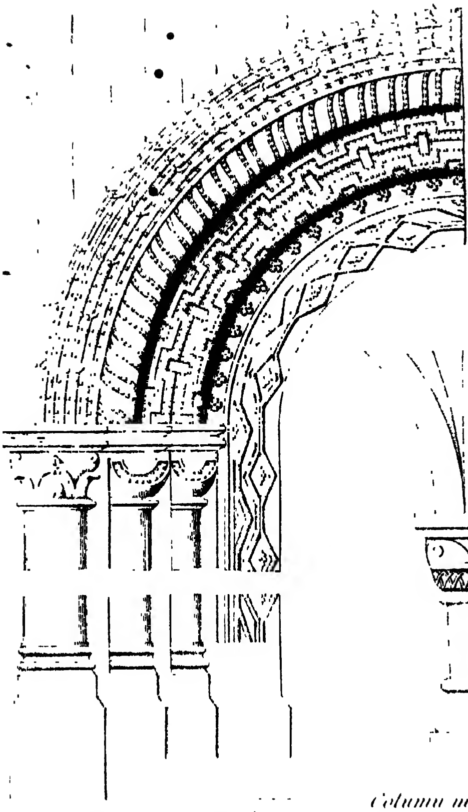
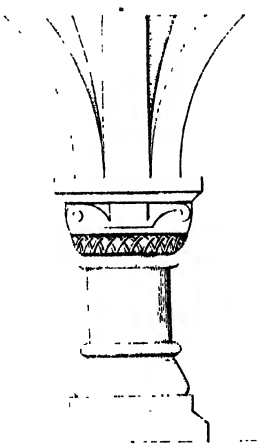


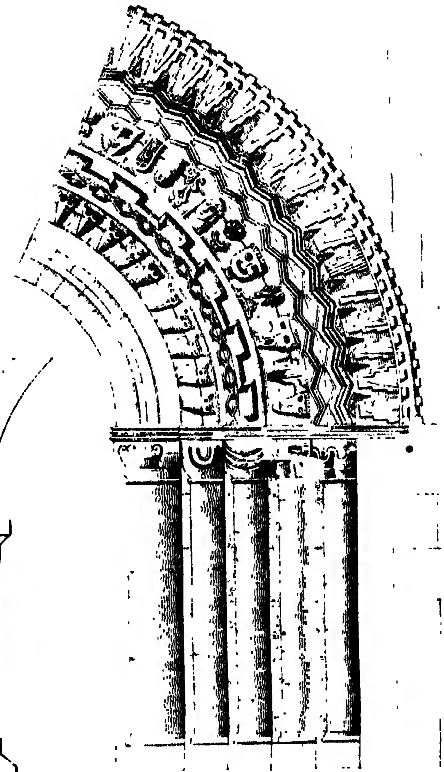
ENGLAND AND WALES
Scale of English Miles
Railways
NORTH SEA
IRISH SEA
ENGLISH CHANNEL
ST GEORGES CHANNEL
BRISTOL CHANNEL
CARDIGAN BAY
CAERNARVON BAY
SOLWAY FIRTH
THE WASH
I. OF WIGHT
NORTHUMBERLAND
SCOTLAND
Meridian of Greenwich
Longitude West 4 from Greenwich
Longitude East



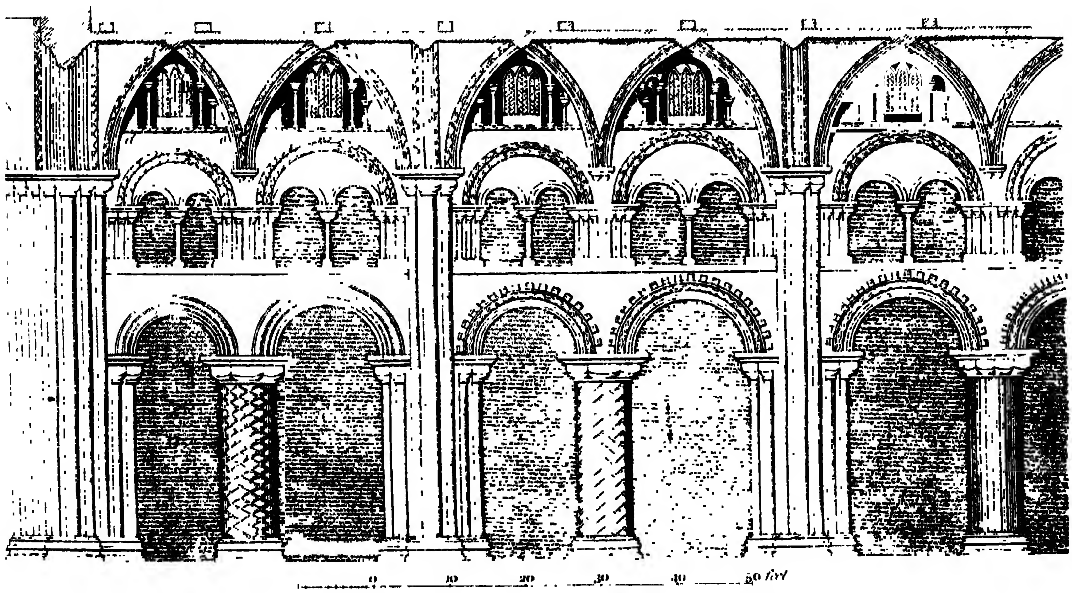
Door way in the South Aisle Durham Cathedral



Column in the Crypt of Lastingham Church Yorkshire



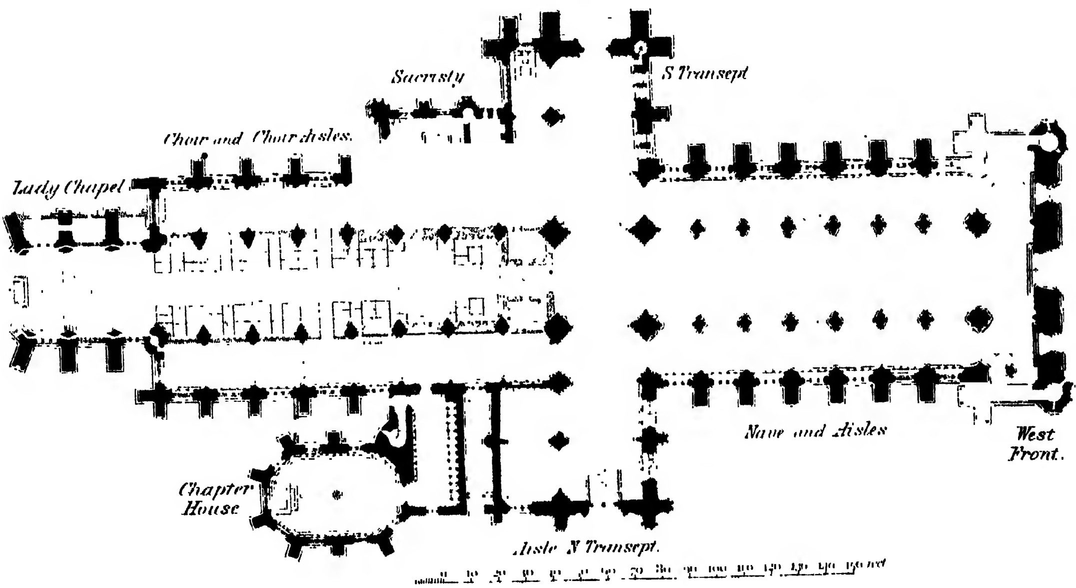
Part of an Elliptical Arch in Tickencote Church Lincolnshire



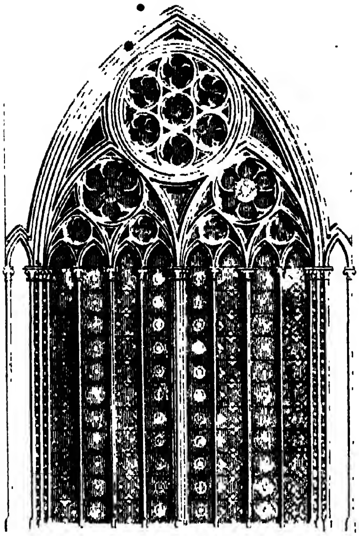
Longitudinal Section of part of the Nave in Durham Cathedral

Chapter House | *Window of The 5 Sisters* | *N. Transept with Aisles* | *Central Tower* | *Nave and Aisles Roof 100 ft* | *West Front Towers 200 ft.*

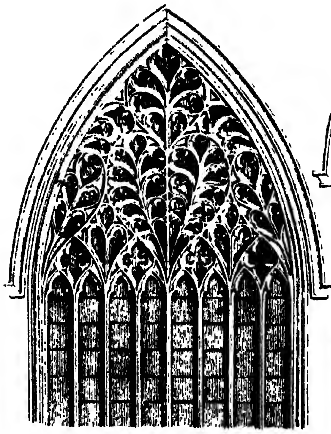
York Minster from the north west



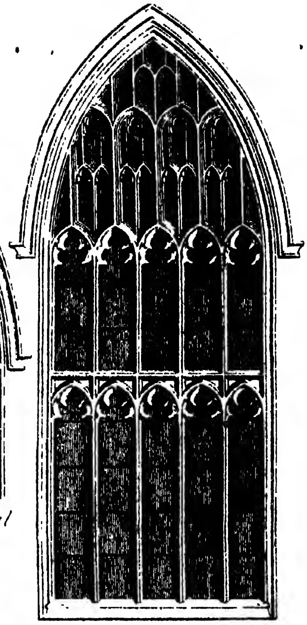
Ground Plan of Lichfield Cathedral



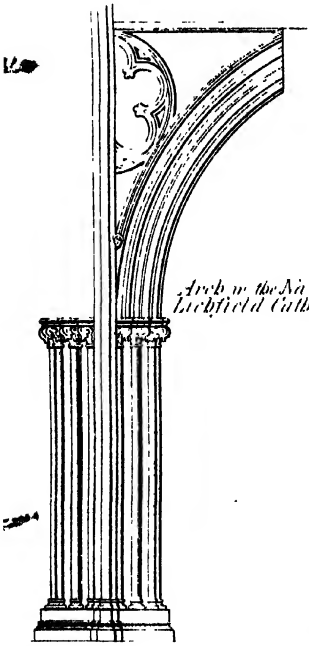
Window at the east end of Lincoln cathedral



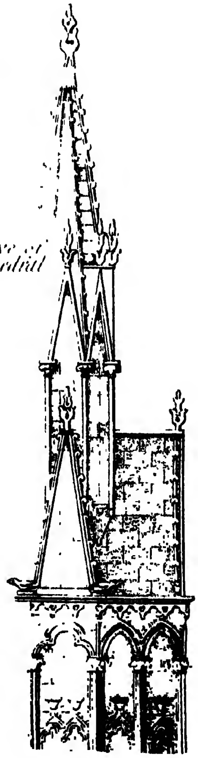
Great West Window, York cathedral



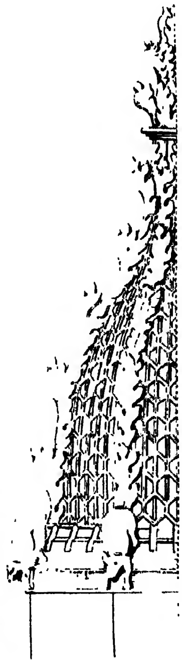
Window from the tower of Mary Magdalen at Taunton



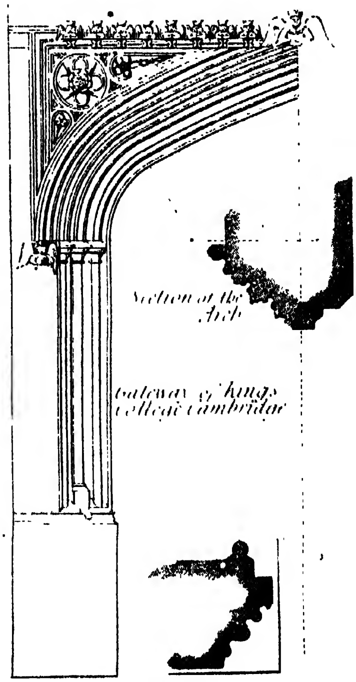
Arch in the Nave of Lichfield Cathedral



Pinnacle on one of the Buttresses of Lincoln cathedral

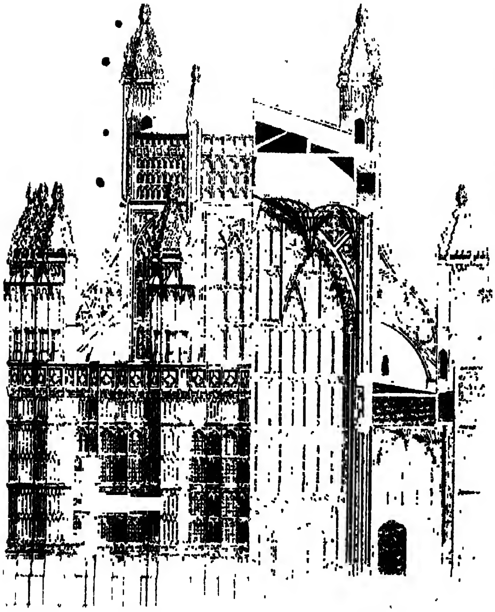


Pinnacle of a Buttress, Henry VII's Chapel. Westm. Abbey.

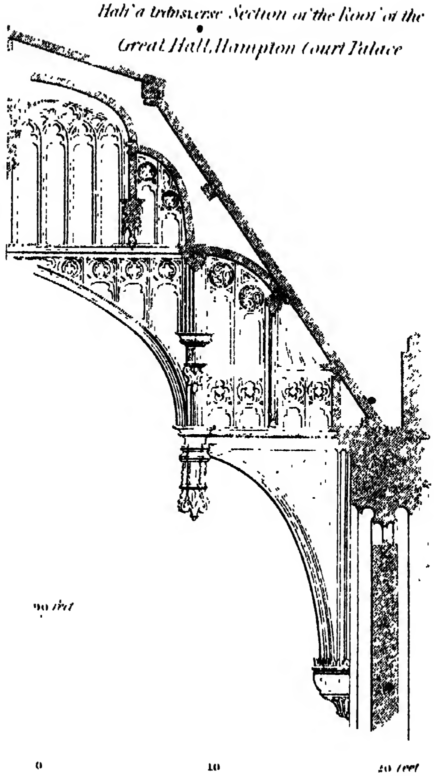


Section of the Arch

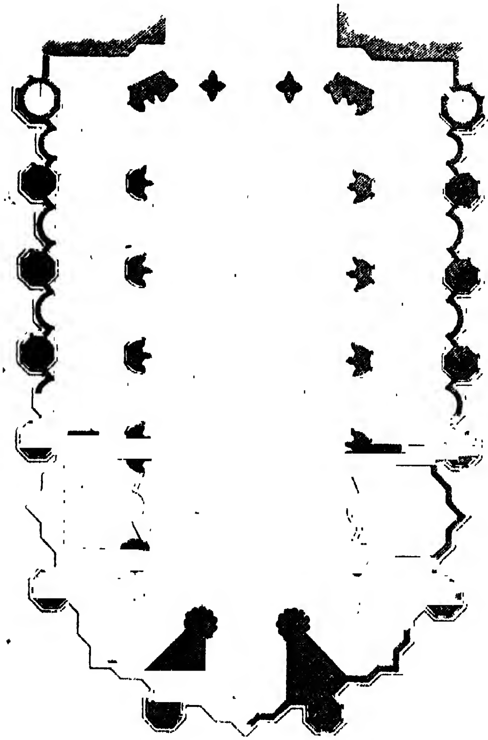
Gateway of Kings college Cambridge

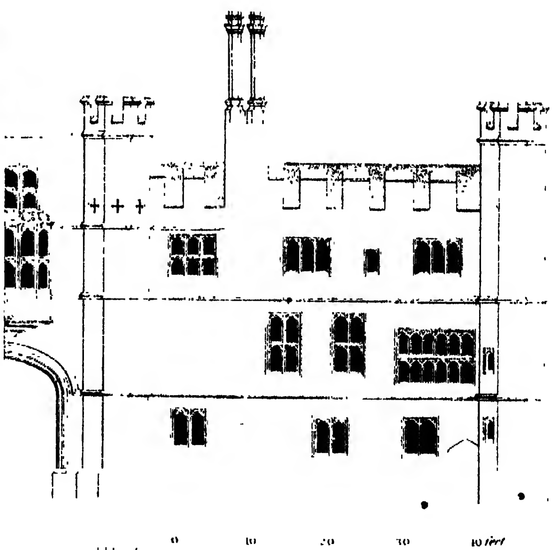


Half a transverse Section of the Roof of the Great Hall, Hampton Court Palace



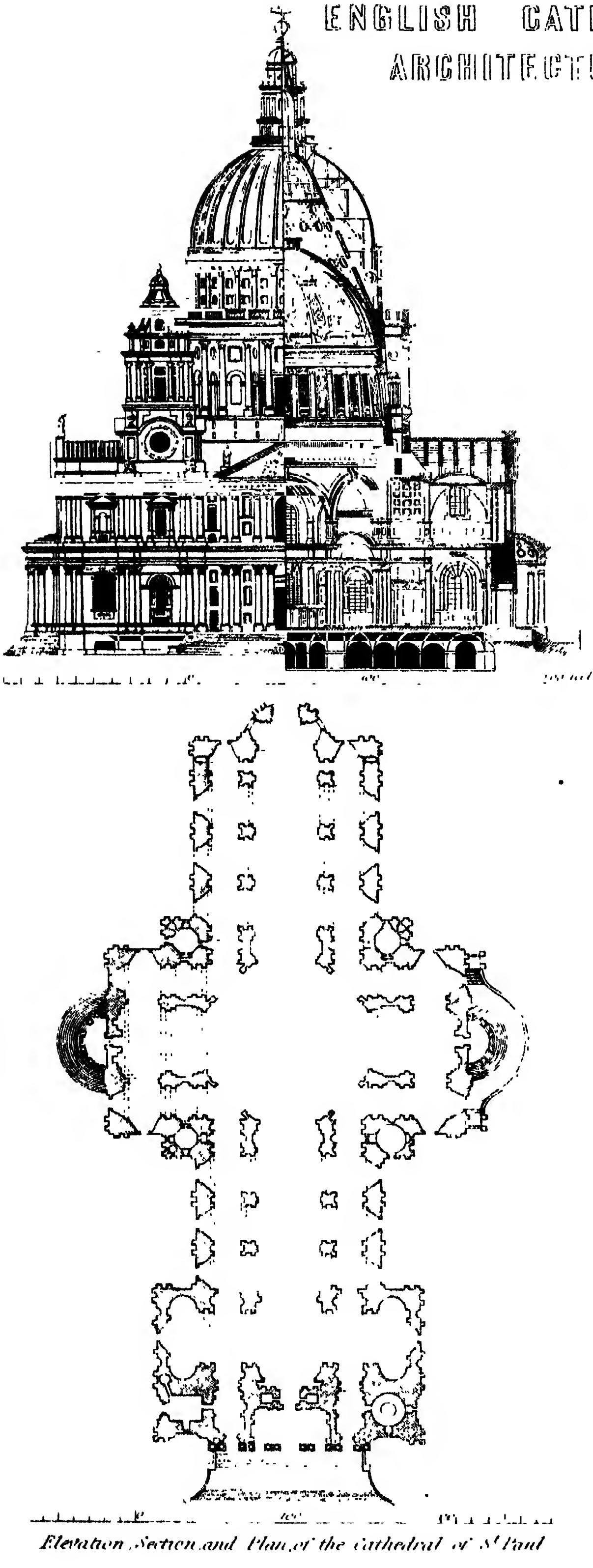
Half Elevation and Section and a Plan of Henry the Seventh's Chapel at Westminster



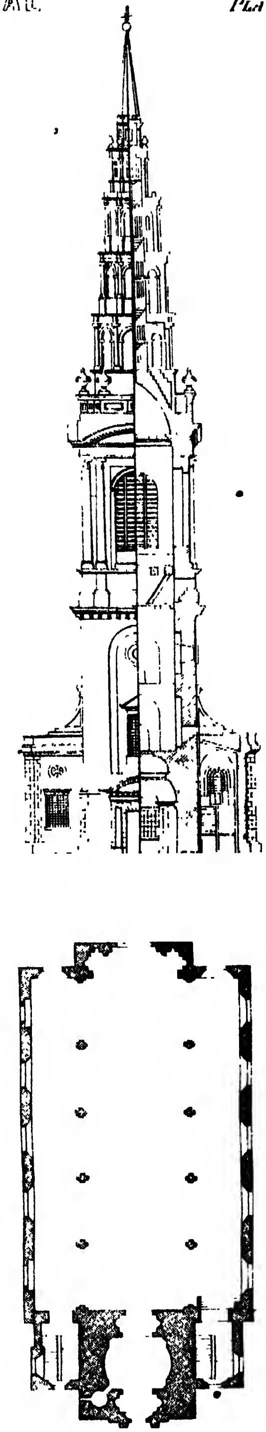


Elevation of part of the inner quadrangle Hampton Court

ENGLISH CATHEDRAL ARCHITECTURE.

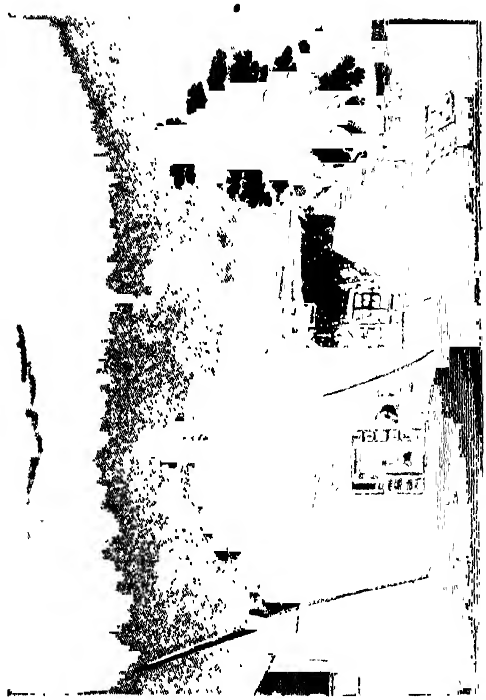


Elevation, Section and Plan, of the Cathedral of S^t Paul



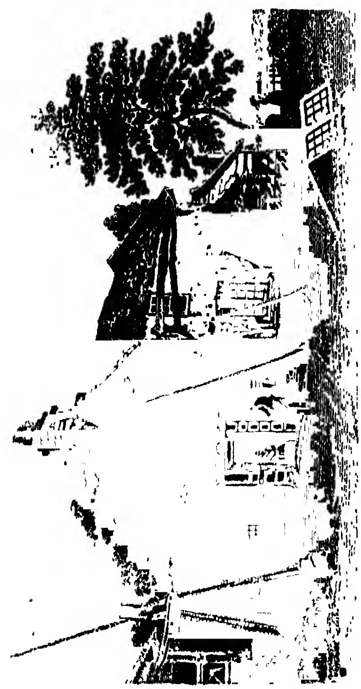
Elevation, Section and Plan, of the Church of S^t Bride, Fleet Street

AQUATINTA.



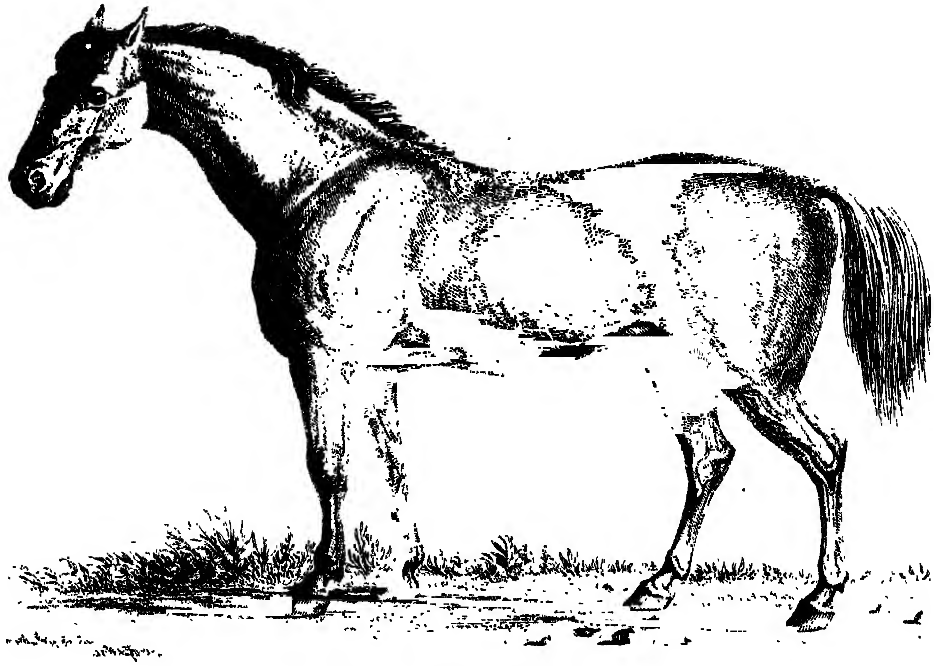
LINE FINISHED.

MEZZOTINTO

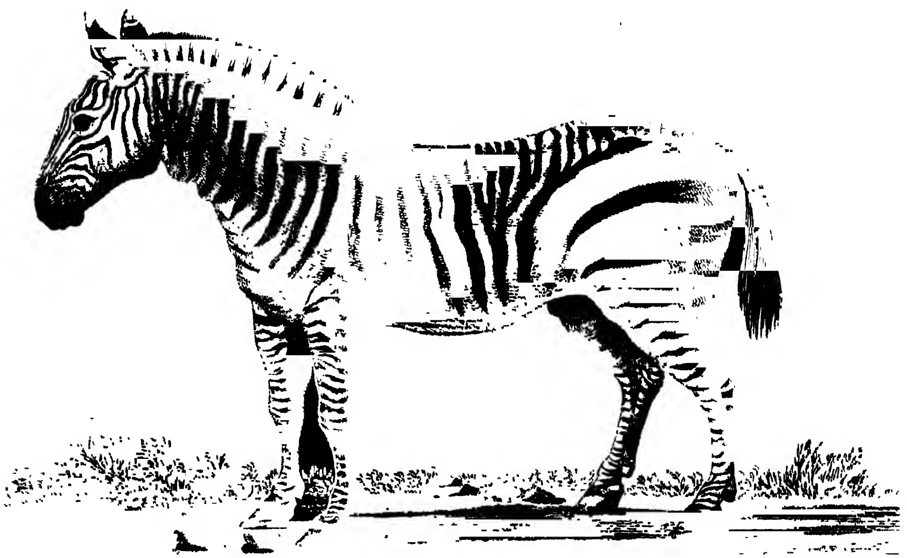


ETCHED

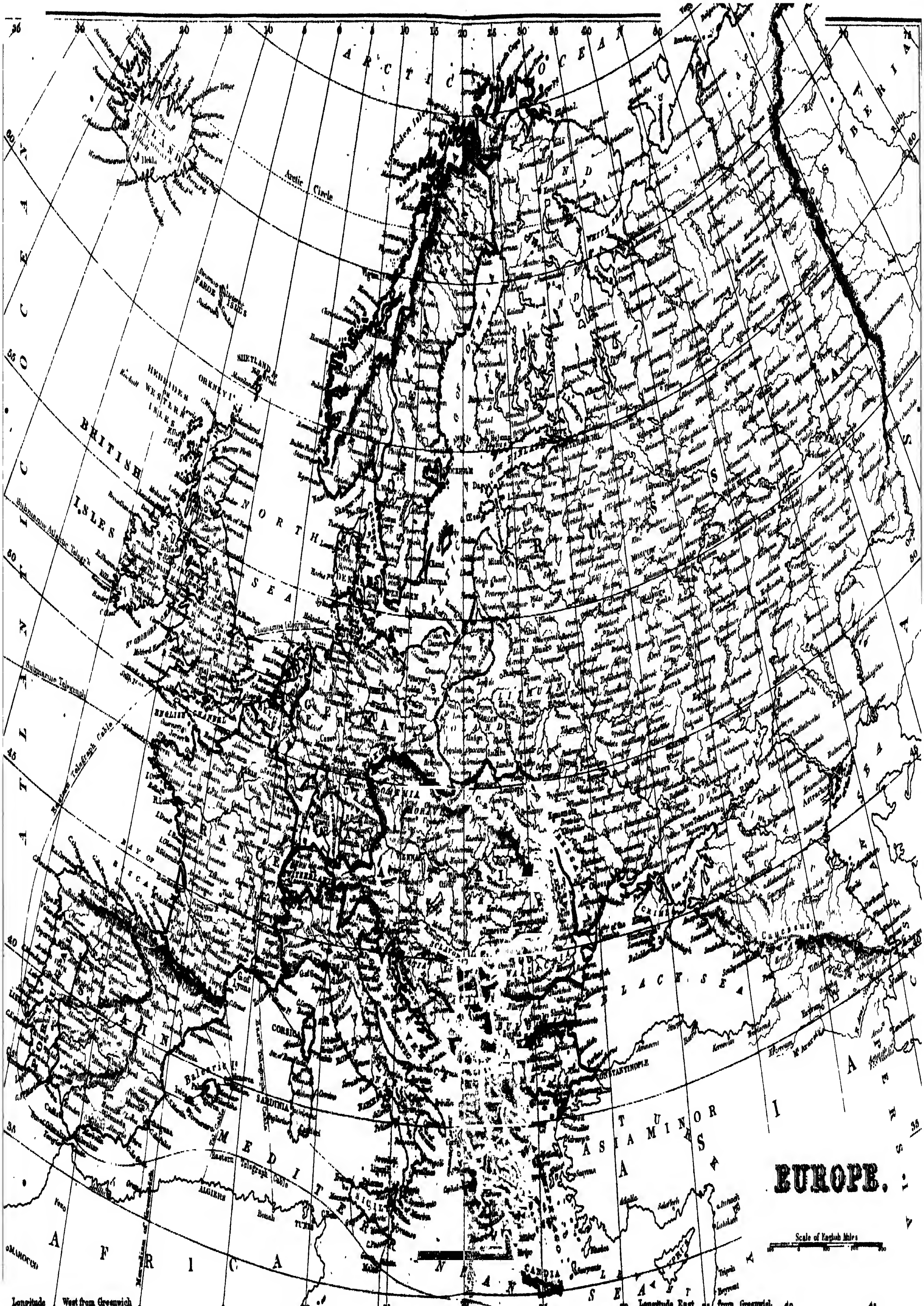
EQUIDÆ.



Equus caballus. Horse.



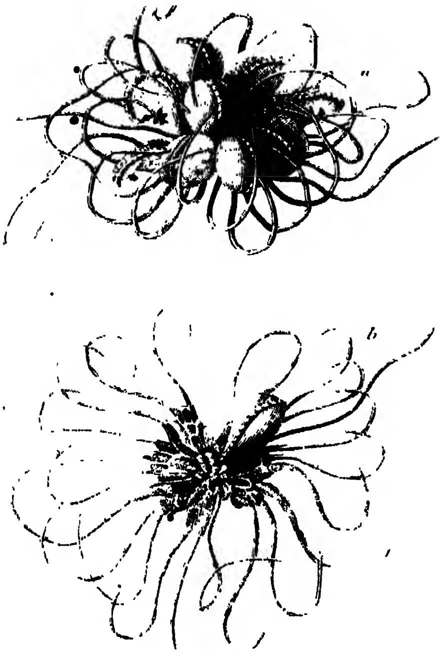
Equus zebra. Zebra.


EUROPE.
Scale of English Miles
Longitude West from Greenwich
Longitude East from Greenwich
ARCTIC OCEAN
Arctic Circle
FAROE ISLES
SHETLAND
ORKNEY
HEBRIDES
BRITISH ISLES
NORTH SEA
ENGLISH CHANNEL
Submarine Atlantic Telegraph
Submarine Telegraph
Eastern Telegraph Cable
STOCKHOLM
DENMARK
GERMANY
FRANCE
SPAIN
CORSICA
SARDINIA
ALGIERS
MOSCOW
BLACK SEA
CONSTANTINOPLE
CANDIA
ASIA MINOR
AFRICA
Caucasus Mts

EUROPE UNDER THE EMPIRE OF CHARLEMAGNE.

EUROPE AT THE DISMEMBERMENT OF THE CARLOVINGIAN EMPIRE.

FERNS.



Magnified Sori

Lastrea filix-mas.

Polypodium vulgare.

4

Asplenium viride.

5

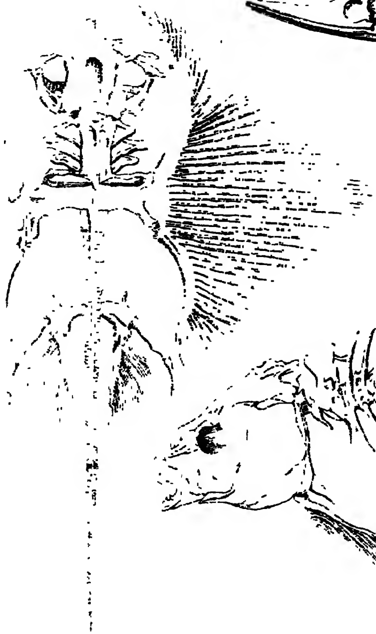
Cystopteris montana

6

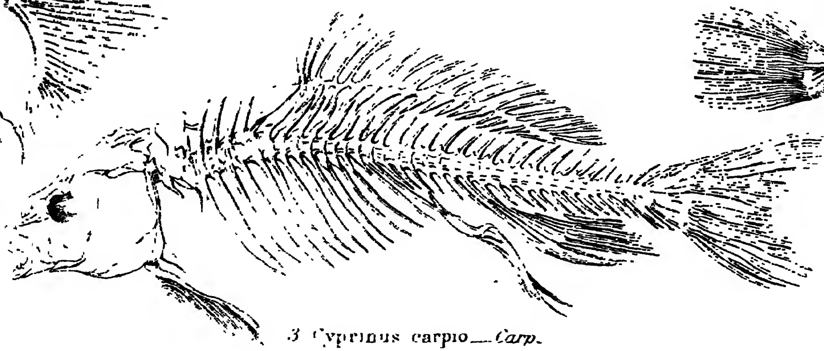
Hymenophyllum tunbridgense.

COMPARATIVE VIEW OF SKELETONS

2 Acipenser ruthenus. *Sturgeon (Sterlet*

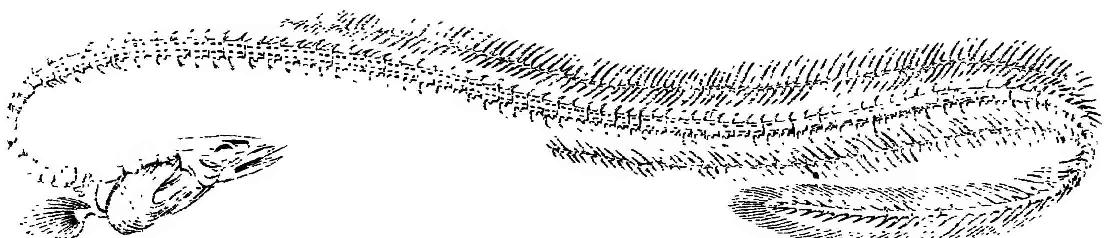


1 Raia batis *Skate*



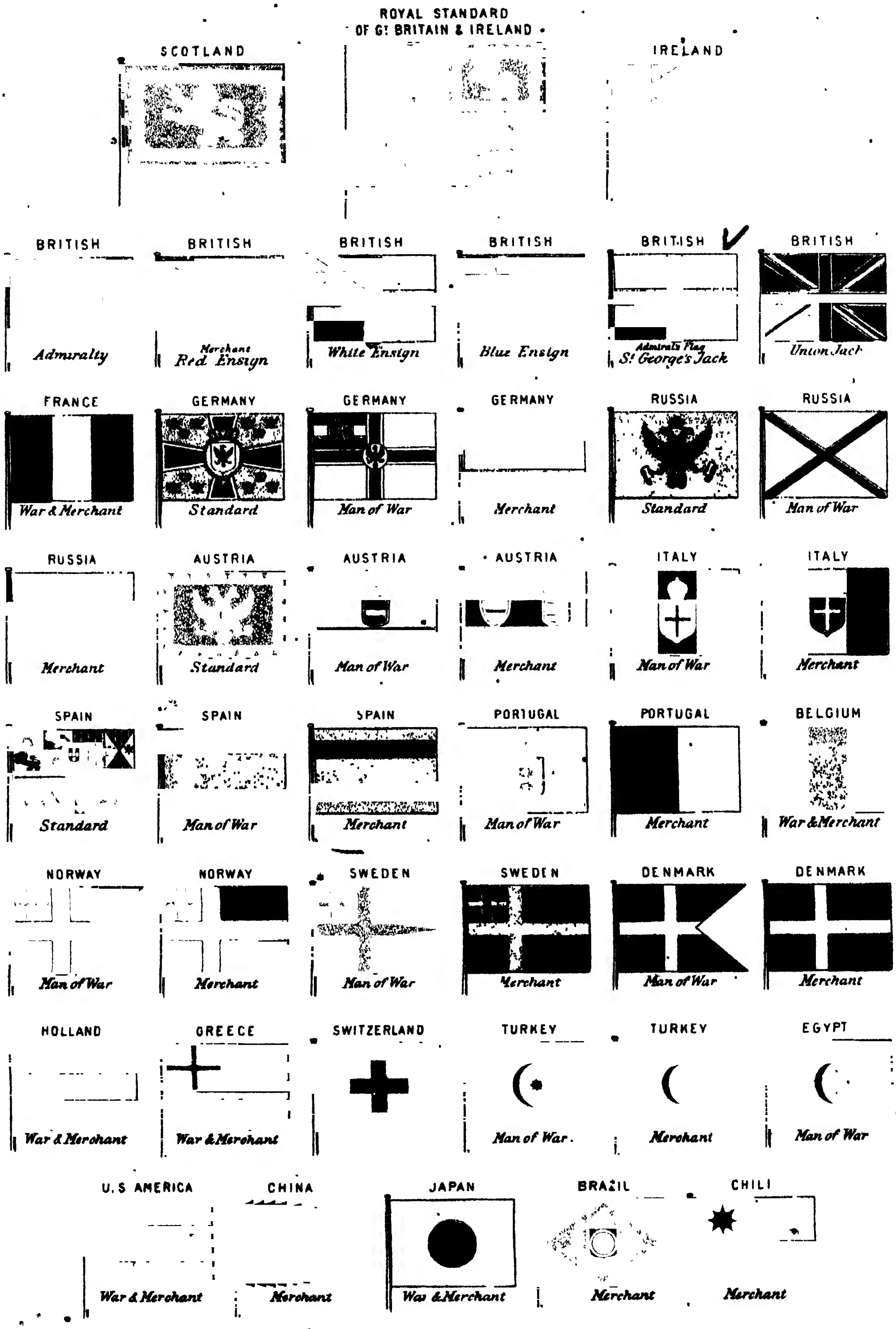
3 Cyprinus carpio.—*Carp.*

4 Pleuronectes flesus. *Flounder*



5 Anguilla vulgaris *Eel.*

F L A G.



ROYAL STANDARD OF G^T BRITAIN & IRELAND
SCOTLAND
IRELAND
BRITISH
Admiralty
BRITISH
Merchant Red Ensign
BRITISH
White Ensign
BRITISH
Blue Ensign
BRITISH
Admirals Flag
St George's Jack
BRITISH
Union Jack
FRANCE
War & Merchant
GERMANY
Standard
GERMANY
Man of War
GERMANY
Merchant
RUSSIA
Standard
RUSSIA
Man of War
RUSSIA
Merchant
AUSTRIA
Standard
AUSTRIA
Man of War
AUSTRIA
Merchant
ITALY
Man of War
ITALY
Merchant
SPAIN
Standard
SPAIN
Man of War
SPAIN
Merchant
PORTUGAL
Man of War
PORTUGAL
Merchant
BELGIUM
War & Merchant
NORWAY
Man of War
NORWAY
Merchant
SWEDEN
Man of War
SWEDEN
Merchant
DENMARK
Man of War
DENMARK
Merchant
HOLLAND
War & Merchant
GREECE
War & Merchant
SWITZERLAND
TURKEY
Man of War.
TURKEY
Merchant
EGYPT
Man of War
U.S. AMERICA
War & Merchant
CHINA
Merchant
JAPAN
War & Merchant
BRAZIL
Merchant
CHILI
Merchant

LIST OF PLATES.

VOL. V.

To be Bound at Commencement of Volume in Following Order.

THE

NATIONAL ENCYCLOPÆDIA:

A DICTIONARY OF

UNIVERSAL KNOWLEDGE.

DIET. The question of diet is one of much importance, and it is also one which is somewhat difficult to determine accurately, as it must vary much with the taste and condition of the individual. Men require more food per day than women, and those engaged in hard manual exercise more than those employed in sedentary work. Physiologists have for a long time divided food into five classes—viz. the starchy or saccharine, the oleaginous or fatty, the mineral or saline, the albuminous or proteid, and the aqueous or liquid.

1. The *starchy* or saccharine food forms a large element in the composition of wheaten bread, rice, arrowroot, potatoes, sago, &c. Starch is a complex chemical compound of carbon, hydrogen, and oxygen, and such bodies are termed hydro-carbons. The fat or adipose tissue in each individual is stored up in proportion to the amount of starchy food taken, and infants are thus much fatter than adults, because they are accustomed to live almost entirely on farinaceous food, which contains a great deal of starch. Starch becomes converted into sugar, and is thus rendered capable of assimilation by the body, when it mixes with the saliva; in this way, when a piece of bread or potato is well masticated, a large amount of sugar is formed. The sugar so formed differs slightly in composition from the ordinary cane or loaf sugar, but it is chemically the same as that present in ripe fruits, &c. 2. The *oleaginous* or fatty kind of food consists of butter, lard, suet, the fat part of meat, and rich greasy foods. Like the last kind they consist of carbon, hydrogen, and oxygen, and form, when used up in the human economy, water and carbonic acid. This kind of diet also tends to make persons fat, and a common example is seen in the case of those who take cod-liver oil; those who naturally are too corpulent should avoid taking saccharine or fatty substances as far as possible. The above are considered the heat-producing foods. 3. The *mineral* or saline variety of food is found in nearly every article of diet; common salt is a familiar example. In ordinary drinking water, in milk, in bread, and in fact in every animal and vegetable product, there is more or less saline matter. It is one of the most important constituents for the formation of tissues not only in the bones and teeth, &c., but also in the muscles, and during fœtal life the child is nourished by a fluid which contains a good deal of common salt. Wherever vital changes go on rapidly saline matters are essential; without them the health fails, and many diseases have arisen from the want of salt during long sieges. 4. The *proteids* or *albuminoids:* these consist of hydrogen, nitrogen, carbon, and oxygen, and are also called nitrogenous substances, from their containing nitrogen. The lean of all kinds of meat, the white of an egg, the casein of milk and cheese, the gluten of bread, the flesh of pease, beans, lentils, and onions, are common examples of this kind of food. While saline substances are readily absorbed by the stomach without undergoing any change, proteids need much preparation before they can be taken up by the lacteals and introduced into the economy [see DIGESTION]; they help to build up muscular tissues, and are thus required by those who lead active lives, and who undergo much exertion. Hence this indispensable class of foods are called flesh-formers. 5. The *aqueous* or liquid portion of our food is too well known to require notice; no substances which we eat are so absolutely dry as to contain no water, and in some vegetables the proportion is enormous. 6. Finally, there are certain CONDIMENTS, such as mustard, pepper, pickles, &c., which are not essential as foods, but which tickle the palate and cause an increased secretion of saliva and gastric juice, and thus promote digestion. From this brief survey it will be seen how valuable milk is during the growth of children, for it contains in a liquid and soluble form all the elements necessary for the growth of the body; the cream contains oily matter, while the remaining liquid portion consists chiefly of water holding in solution saline, saccharine, and albuminous matters. Bread is a valuable article of diet, inasmuch as it contains water, salt, starchy and albuminous materials. Thus two cheap and common articles of diet contain all that is essential for human life. An ordinary joint of meat contains albuminous matter, as shown by the amount of lean, associated with more or less of fat and aqueous material, and in addition a small quantity of salt. An egg is a good example of a mixture of different kinds of food; the yolk contains much fatty matter, while the white of an egg is made up chiefly of albumen, water, and salt. Beer contains saline and saccharine matter in combination with alcohol and water; the hops only aid in giving a bitter flavour, and promoting the appetite; the strength of the beer depends on the malt it contains; this fluid, it will be seen, tends to promote the growth of fatty tissues, but is not of much use in the formation of muscle. Tea, coffee, and cocoa contain chiefly water when taken as beverages, and, in addition, sedative and tonic properties; cocoa contains a good deal of fatty and saccharine matter, and is very nourishing.

It is difficult to lay down any strict rule as to the amount of food to be taken in twenty-four hours by adults; men, as already observed, require more animal food than women, and those engaged in active exercise much more than those who live a sedentary life. Navvies and labourers can get through much more work in a day when well fed than when living on a moderate diet. The different kinds of food should be well apportioned; it is equally as bad to live on a purely farinaceous diet as it would be to take only fat or meat. What is required for a state of health is to take a fair proportion of each. Hunger is the best

test as to when a man should eat, but it is often very unwise to go on eating until a feeling of fulness and engorgement ensues; it is important also that meals should be taken with regularity. Many people eat too much, and this has its evils just as much as excess of drinking. It has been estimated that the food required every twenty-four hours by a man in full health and taking free exercise is—of meat, 16 oz.; bread, 19 oz.; fat, 3½ oz.; and of water, 52 fluid oz.; that is, about 2½ lbs. of solid food and about 3 pints of fluid.

The wealthier classes only, who take animal food at breakfast, lunch, and dinner, can afford this large proportion of 16 oz. of meat a day. The poorer classes manage to subsist on a very small proportion of meat; frequently they have this kind of food only once a week, and as they live chiefly on bread, broth, tea, and now and then bacon, their physical standard is not very high. The French take much less animal food than the English. Of the different kinds of meat mutton and roast beef are the most digestible; salt beef, bacon, pork, and veal rank next in order. Many varieties of birds and of fish are highly digestible. Bread is taken at most meals, either simply or as toast; or the same elements of food are taken as biscuit, cake, &c. It forms an important element of diet; for not only is it cheap, but it contains four out of the five kinds of food. Life can be sustained for a long time on bread and water. Fruits or preserves made into puddings or tarts are excellent articles of diet, as are light puddings made of rice, arrow-root, tapioca, &c. The following substances should be avoided by a fat man, or at least taken only in moderation:—Fat of meat, bacon, pork, &c.; white bread, potatoes; starchy food, as tapioca, rice, arrow-root; sugar, beer, and heavy wines or spirits. The following articles may be taken without fear of forming too much fat:—Brown bread, toast, biscuits, rusks, lean of any kind of meat, fish, fowl, or game; green vegetables, as cauliflower, asparagus, and lettuce, celery, fruit, either cooked or fresh, jams in moderation, and light wines. Of course no one can strictly adhere to this plan, but attention to its leading principles will soon make a vast improvement in the ease and condition of the individual. For people who are thin a converse plan may be in part adopted.

Moreover, if health be the object of diet, it should be remembered that mere dieting will not serve the purpose. If the constitution be weak or predisposed to some special disease, the ordinary rules of diet must be varied to suit the individual case. Overwork and the opposite extreme of an inactive idle life should both be avoided, and brisk daily exercise, fresh air, regular hours of rest, and a cheerful even temperament are indispensable accessories to diet in the promotion of health. For a healthy person stimulants of any kind whatever are wholly unnecessary and best avoided. Water is the natural drink of man, and may always be taken in moderation when thirst is present. It performs important purposes in the animal economy, and is absolutely indispensable for life and health. Water enters largely into combination with all our food, and acts as a solvent of everything we take. It also acts as a vehicle to convey the more dense and less fluid substances from the digestive tract to their destination in the body. It gives fluidity to the blood, holding in suspension or solution the red corpuscles, albumen, fibrin, and other constituents which enter into the different structures of the body, the whole of which are formed from the blood. Not only the soft parts of the body, but even the very bones, or the materials of which they are composed, have at one time flowed in the current of the blood. To show how essential water is for the development and maintenance of the animal body, we have but to remember that a human body weighing 154 lbs. contains 111 lbs. of water. Such a fact should suggest the necessity for obtaining water pure, and taking it unpolluted by animal and mineral ingredients. This provided, there is no doubt whatever that water is the most wholesome drink under all circumstances of health, while stimulants, seldom necessary, are often positively injurious.

DIETRICH OF BERN, one of the heroes of the Nibelungen legends, has been sought to be identified, though with somewhat indifferent success, with Theodoric, king of the Ostrogoths. Bern is certainly Verona, but Dietrich probably has no more historical existence than the later Romeo and Juliet of that same city. Dietrich with his sword Nagelring, conquering the giant Sigenot, gaining his wife Virginal from Elfland, or protecting Laurin, the dwarf king of the magic Rose Garden, is well known to readers of the myths of the middle ages. Dietrich was driven from his kingdom by the Emperor Ermenrich, and took refuge with Etzel, king of the Huns (Attila), and it is this friendship which connects him with the Nibelungen-lied. After a short stay with Etzel, Dietrich with many comrades, new and old, invaded his old kingdom and reconquered it; but only subsequently to lose all, except his life, at the great battle of Ravenna, that "Raven-fight" which looms gigantic through the half darkness of mythic time, the type of fierceness and desperate war, each side crushing the other into a common ruin. A second refuge with the friendly Etzel was followed by a second attack on his kingdom, which he this time not only successfully reconquered, but held permanently till his death. This happened in true romantic wise: for one day, while out hunting, Dietrich saw a fine coal-black steed approach. Leaping on this he rode away and onward ever faster till his followers lost sight of him. Thus riding, and always riding, he disappeared for ever.

While a refugee at Etzel's court for the second time Dietrich took part in the tragedy of the Nibelungs (see Nibelung, Brunhild, Chriemhild), and it was he who took prisoner the only surviving Burgundians, King Gunther and his uncle Hagen, after the terrible slaughter of all besides, and delivered them bound to Chriemhild. To Dietrich's disgust she avenged her wrongs by causing Gunther to be beheaded, and with her own hands afterwards murdering Hagen. Dietrich's old companion Hildebrand plunged his sword into the breast of the tigress-queen, carried beside himself by the sight of her ferocity.

DIEU ET MON DROIT (God and my right) was the battle-cry of Richard Cœur de Lion at the battle of Gisors in 1198. It was given and taken as a challenge to the feudal superiority of the King of France, to whom the powerful Angevin monarch of England owed allegiance as a vassal for Normandy and Anjou, &c. Richard hinted that God alone was above him. In commemoration of his brilliant victory the motto was added to the royal standard and arms of England, where it has remained ever since.

DIFFERENCE, in heraldry, is a mark used to distinguish the various branches of a family. While the father still lives the brothers' "differences" are called "marks of cadency," and run as follows:—The eldest son bears a label, the second a crescent, the third a mullet, the fourth a martlet (bird), the fifth an annulet (ring), the sixth a fleur-de-lis, &c. [See Heraldry.] If the second son has a family their marks of cadency are superposed upon his; thus his eldest son has a label, his second son a crescent, his third son a mullet, &c., all superposed upon the father's crescent; and with the other sons' families similar differences are charged as with that of the second son.

After the father's death marks of cadency give place to differences proper, which consist of particular bordures round the shield of the head of the house. The family arms of course descend to the eldest son, who now becomes the head of the house, the second brother adds a plain bordure round these arms, the third an ingrailed bordure, &c. This seems to be the correct practice, but heralds have never been thoroughly agreed upon the subject, and there have been many departures from the rule given above,

so far as regards the precise differences or marks of cadency adopted, and so far as regards the change at the father's death. The latter has been very frequently neglected in France, for example.

The usage of the royal family is somewhat peculiar as to marks of cadency. The Prince of Wales, as eldest son, bears the label on his arms (label three points argent), and the other princes and princesses also bear the label, but with certain marks (as a cross, a fleur-de-lis, &c.) superposed upon the label, as in the case of the sons of an ordinary second house given above.

For very many persons the subject of heraldic differences would not present interest were it not that a famous passage in "Hamlet" perpetually calls attention to it, and what Shakspeare alludes to becomes a subject of importance to every Englishman. Ophelia says, in the strangely pathetic mad-scene which has for centuries moved audiences to tears, as she presents flowers and grasses to those she meets, and gives a sprig of rue (emblem of sorrow) to the queen:—

> "There's rue for you, and here's some for me—we may call it herb o' grace o' Sundays——oh! you must wear your rue with a difference," &c.—"*Hamlet*," Act iv., scene 5.

Ophelia, as Hamlet's wife, would become allied to the head of the house; Gertrude, the wife of the usurping brother of the dead king, Hamlet's father, had in strictness descended to the second house. To Hamlet, of right, the pure arms (and the royal succession) belonged; to his uncle Claudius only the arms of the second house with the appropriate difference. Ophelia's parenthesis cuts with a keen edge, therefore, mad though she be; and thus does the great poet make every trifle serve his end.

DIFFERENCE, CALCULUS OF DIFFERENCES. Difference, in mathematics, is the excess of one quantity over another. This fundamental meaning of the term is almost lost in the higher parts of mathematics, from the association of it with a methodized theory derived from the consideration of the differences presented by successive quantities which follow a regular law. It is therefore a very wide branch of pure mathematics which must be considered under this term, namely, the method or calculus of differences.

Suppose a series of numbers to be given, say 43, 47, 53, 61, &c., and the question to be put—What is the FUNCTION of x (a variable quantity) which, when x equals 1, 2, 3, &c., will give the series 43, 47, 53, &c.? This problem is indeterminate with respect to ordinary algebra, unless we can ascertain a law by which the series could be extended *ad infinitum*. This law may be probably found, if it exist, by taking the difference between the terms (Δ), and if that does not show the law by taking the difference between these differences (Δ^2), and so on. Thus in the case in question, Δ gives

	43		47		53		61		71
(Δ)		4		6		8		10	
whence (Δ^2)			2		2		2		

This series is manifestly determinate, and can be brought under the known rules of algebra. The "calculus of differences" (or, as it should be called, the "calculus of finite differences") was first worked out by Dr. Brook Taylor (1685–1731) in the celebrated Taylor's theorem, but under the title of the "method of increments," *increment* being the older English term for what, following Leibnitz, we now call *difference*. As has been said, it is a perfectly determinate calculus, and must be carefully distinguished from the DIFFERENTIAL CALCULUS. It is almost to be regretted that the term "calculus of differences" should have superseded the original term "method of increments," since it is calculated to cause confusion.

If, instead of the increments being finite, we are permitted to adopt the transcendental analysis, and consider them as continuous and growing, we then get the idea of a differential. It is as if, to use a rough simile, we regarded not the number 3 (for example), but a quantity which was developing towards the number 3, and that by steady progress, and not by any measurable or finite increments. It is plain, however, that Taylor's theorem, or the calculus of differences, lies at the root of the whole splendid structure of Newton and Leibnitz.

DIFFERENCE, PERCEPTION OF, in philosophy, is one of the fundamental properties of mind. It is even a part of memory, for it is upon this that associations of CONTRAST depend. Objects and qualities tend not only to call up their like, but their unlike, from the memory. Hot always implies cold, dry suggests wet, &c. This habit of the mind is called *relativity*.

The power arising from the perception of difference is that of discrimination, and without this it is manifest that no knowledge is possible. If all things were to taste alike we could not tell white sugar from salt; if our nerves of hearing are injured we cannot distinguish sound from silence, &c. Perception of difference is at the root of every idea whatever, and, roughly speaking, the more discriminative a being is the higher he stands in the rank of creation. We all admit that a dog is superior to ourselves so far as smell is concerned, for instance; that is to say, we measure his rank by his power of discrimination. Further, besides being a part of the memory in forming associations of contrast, relativity operates universally in every department of knowledge. Silence is a meaningless word to him who knows no sound; indeed, everything is known only as a contrast to something else. Absolute (non-relative) knowledge is impossible to man.

DIFFEREN'TIAL CAL'CULUS, the name given by Leibnitz to the science which was digested nearly about the same time by himself and Newton, independently of each other, and which has of late years almost exclusively prevailed in this country, to the exclusion of the name, notation, and (so far as they differ) methods of Newton's fluxions.

It is impossible, in the smallest degree, to exhibit the present state and uses of a science into which all others merge as the student approaches the higher applications of mathematics, but the object of this masterpiece of mathematical method may be gathered from what has been said in the article DIFFERENCE. The successive differences between two variables in their successive states of variation may practically always be brought under some law, as there shown; and if these differences be taken to be infinitesimally small, and to be regarded in fact as in the act of occurring, we reach the conception of the transcendental analysis. Or, to put it another way, we may regard number as continuous, so that 2 is conceived as proceeding towards 3 by infinitesimal and gradual accretions; and we then proceed to treat of the *differentials* or varying values of difference between the number at one stage of its process and at another infinitesimally close to it. There is precisely the same difference between the differential calculus, dealing with ever-varying values in the act of variation, and the finite rigid algebra, as there is between the sough of the wind making wild melody round the angles of a house in a storm and an air played upon the pianoforte, made up of precise and known intervals. This conception, apparently impossible to the unlearned, was worked out by Newton in fluxions, and by Leibnitz in the differential and integral calculus. For the relative parts taken by these two great men in formulating the calculus the reader is referred to the article FLUXIONS, where a sketch of the famous controversy is given. Newton undoubtedly has priority; but whether Leibnitz can or cannot justly claim perfect originality for his method, this much he has certainly attained—the notation and

method of the differential calculus have now quite superseded those of fluxions as left by Newton. Some mathematicians consider that a mixture of the two notations is in many cases the most useful form.

On the history of the science since the time of Newton there is no work from which we can trace out a connected account of the various steps by which the present system has been formed. In fact most of the new investigations have been made with reference to some particular points of physical science. It would be very difficult to write the history of this calculus without entering at the same time into that of mechanics, optics, astronomy, &c., and of every subject to which it has ever been applied. An attempt at the former without the latter would be an account of the progress of language without mention of literature, oratory, or the drama.

The precursors of Newton and Leibnitz, namely, Archimedes, Cavalieri, Wallis, Barrow, Fermat, Roberval, and others, touched so near upon the differential calculus that it is obvious any of them might have taken the place of either of the first if they had possessed more powerful means of algebraical development. After Vieta, Descartes, Wallis, and Newton (considered only as the discoverer of the binomial theorem), the step to a formal calculus was comparatively small. The essential part of the difficulty had been removed, and by much the greater part of the distance between Archimedes and Leibnitz had been gained. This point once attained, *methods* sprung up with rapidity, and in little more than a century we find the introduction of the various schemes which it will be necessary to mention, namely—Leibnitz's method of infinitesimals, Newton's method of prime and ultimate ratios, Newton's method of fluxions, D'Alembert's method of limits, Landen's method of vanishing fractions, or residual analysis, and Lagrange's method of derivation. If we distinguish carefully between the first principles of a method and the manner in which those principles are applied to algebra, it would not be any great stretch of assertion to contend that all the methods except the last are different ways of expressing the same fundamental ideas.

The method of Leibnitz (infinitesimal calculus) assumes that quantities are made up of infinite numbers of infinitely small parts. It is a sort of atomic theory of pure magnitude, which is most obviously either false or obscure; for, so far as infinitely small quantities can be definitely explained, it is obvious that there are no such things, and any obscurity left in their definition extends itself throughout the whole science. But the falsehood of the supposition is not absolute, for though magnitudes cannot be distinctly laid down to be composed of an *infinite* number of *infinitely small* parts, yet any magnitude can be divided into a number of parts *greater than any we may happen to name*, each of which parts shall be *less than any magnitude we may happen to name.*

The system of Newton, known by the name of prime and ultimate ratios, was set forth in the first section of the "Principia," and is the method pursued throughout that work. It is in reality a method of limits, exhibited in a form which allows of a more ready application to geometry than to algebra, and accordingly it is abandoned by Newton in his method of fluxions. Instead of considering and comparing simultaneous increments of infinitely small magnitude, the ratios of small but finite increments are taken; and not these exactly, but the limits towards which they approach when the increments are diminished, which are called *ultimate* ratios, or *nascent* ratios, according as the ratios are supposed to be growing from nothing or diminishing to nothing.

The method of fluxions was also given by Newton and with a peculiar notation, which maintained its ground in this country until about the year 1816. [See FLUXIONS.] There are many fundamental ideas connected with sensible objects, which lead to a practical differential calculus, and might happen to have been the means of suggesting a strict and mathematical theory. Newton adopted one of these, that of velocity, of which it may be said that its assumption as an answer to objections is a formal evasion of all the metaphysical difficulties of the subject. Since the proportions of all quantities may be represented by those of straight lines, the nature of the comparative changes which take place in continuously increasing or decreasing quantities may be referred to the velocities with which the terminal points of straight lines change their places. Velocity once clearly defined in cases where it is variable, there is no further difficulty, but unfortunately a distinct conception of the measure of velocity is precisely equivalent to finding a meaning for the differential coefficient independently of it.

The method of limits of D'Alembert, which is now more frequently used than any other, was considered by the author himself as an explanation of Newton's prime and ultimate ratios.

The two remaining methods (those of Landen and Lagrange) are attempts to establish the science upon purely algebraical principles. Hitherto no one seemed to have perceived, or at all events to have acted upon, the fact that algebra itself contains difficulties of precisely the same character as those in dispute in the differential calculus. Now, if algebra were already firmly established, it seemed feasible to make it cover this calculus also by a little extension.

Landen's method of vanishing fractions, or residual analysis, is in fact merely the algebraical exposition of Newton's (geometrical) prime and ultimate ratios. It is the limit of D'Alembert considered as *attained*, instead of being a limit or goal supposed to be approached as nearly as we please. It is less extensive than the method of Lagrange, but is as far as it goes clearer, and draws less on the disputable part of algebra.

The method of Lagrange was given by him in lectures at the École Normale of Paris, and afterwards published as a theory of functions. Granted the efficacy of algebra for such points, Lagrange is irreproachable; and the attacks upon his method do not sufficiently bear in mind that all he asserted (and must fairly be held to have proved) was that algebra, good or bad, as it stood was competent to solve the problems of the calculus without the use either of limits or of infinitesimals.

We shall now state two propositions, one geometrical, the other algebraical, in the words of the several systems in the order in which we have described them. It will be seen how surprisingly the statement of the same fact varies in each, and yet how its identity can be clearly maintained.

Infinitesimals.—An infinitely small arc of a circle is equal to its chord.

Prime and Ultimate Ratios.—If an arc of a circle diminish, the ultimate ratio which it bears to its chord is one of equality; or, if it begin to increase from nothing, the prime or nascent ratio of the arc and chord is that of equality. Or the arc is *ultimately* equal to its chord.

Fluxions.—If an arc increase from nothing with a uniform velocity, the velocity with which the chord increases is, at the first moment, equal to that of the arc.

Limits.—If the arc of a circle (and therefore its chord) diminish without limit, the limit of the ratio of the arc to the chord is one of equality.

Residual Analysis.—When the arc of a circle = 0, then

$$\frac{\text{arc}}{\text{chord}} = \frac{0}{0},$$

an indeterminate form, the value of which is ascertained to be unity by clearing the numerator and denominator of a factor which vanishes when arc = 0.

Theory of Functions.—When the arc is expanded in the following series—

Arc $=$ A $\times$ chord $+$ B $\times$ (chord)^2 $+$, &c.,

then A $= 1$.

The second example is algebraical, and would be thus variously expressed :—

Infinitesimals.—If an infinitely small increment, dx, be given to x, then x^3 receives the infinitely small increment $3x^2dx$.

Prime and Ultimate Ratios.—The ratio which any increment given to x bears to the consequent increment of x^3 is ultimately that of 1 to $3x^2$.

Fluxions.—If x be a line which increases with the velocity $\dot{x}$, then x^3 increases with the velocity $3x^2\dot{x}$.

Limits.—The limit of the ratio obtained by dividing an increment of x^3 by the increment of x which produced it, on the supposition that the latter increment diminishes without limit, is $3x^2$.

Residual Analysis.—Since

$$\frac{y^3 - x^3}{y - x} = x^2 + xy + y^2,$$

it follows that, when $y = x$, $\dfrac{x^3 - x^3}{x - x} = 3x^2$.

Theory of Functions.—If $(x + h)^3$ be expanded in a series of powers of h, the coefficient of the first power of h is $3x^2$.

The form in which the differential calculus is brought to bear, though its actual operation is of course beyond the limits of this work, may be roughly shown thus:—Let x and y be two magnitudes which vary, and let, for instance,

$$x = \mathrm{F}(y),$$

where F is any function of y. [See FUNCTIONS.] The differential calculus aims at discovering how x varies when y varies. When x becomes $x + \mathrm{D}x$ let y become $x + \mathrm{D}y$; then, supposing $\mathrm{D}x$ and $\mathrm{D}y$ to diminish until they almost vanish, and at that point to be respectively equal to dx and dy, these latter are differentials of x and y; and

$$\frac{dx}{dy} \text{ is the limit of the ratio } \frac{\mathrm{D}x}{\mathrm{D}y}.$$

The actual amounts of the differentials are not given, but their relative amounts only. The values of x and y being known, the methods of the differential calculus will determine the ratio of dx to dy. It is the function of the INTEGRAL CALCULUS, on the other hand, to find the primary quantities when their differentials are given.

DIFFRACTION OF LIGHT. The peculiar modifications which light undergoes when it passes by the edge of an opaque body are classed as phenomena of the *diffraction* or *inflexion* of light.

When a ray of solar light is transmitted through a very small hole in a card, or is collected in a point by means of a double convex lens, and then diverges from that point, if a small opaque plate of any outline be interposed in the course of the ray, the shadow of this object received on a parallel screen behind will be encompassed by a series of coloured bands or fringes of a similar outline with the body, except at its angular points; the order of the colours in each fringe, reckoning from the outside towards the shadow or inside, is, as in the prismatic spectrum, from red to blue; but the intermediate colours are less distinctly isolated, partaking of a mixture of the extreme tints. The actual shadow, or dark space within the innermost fringe, is also larger than the geometrical shadow which would have been cast if the rays had passed exactly by the edge of the body in straight lines and been received on the same screen. These rays are not propagated in straight lines, but in hyperbolical curves. As for instance in fig. 1, Plate 1, if O be the luminous point, A the edge of the body, G H a screen perpendicular to the straight line O A B, the border, C, of the visible shadow, and D E F the places of the successive minima of the fringes in a line at right angles to the edge of the shadow; the screen being brought nearer to the body A as at $g\ h$, and $c\ d\ e\ f$ being the points corresponding to C D E F, their loci will be the hyperbolas A c C, A d D, &c. The border, C, of the visible shadow will also be seen not to be coincident with B, that of the *geometrical* one, which lies in the straight line O A B. This was explained by Newton by supposing that the rays passing at different distances from the edges of bodies are turned aside outwards as if by repulsive force, and that those nearest are turned more aside than those more remote, as in fig. 2, Plate 1, where X is a section of a hair, and A D, B E, C F, &c., rays which pass at different distances beside it, and which are turned off at angles rapidly diminishing as the distance increases in directions D G, E H, F I, &c. The curve W Y Z will thus be convex outwards, its curvature will be greatest at W, and will diminish continually as it recedes from X. To account for the fringes, he supposed that each ray in its passage by the body undergoes several flexures to and fro, as in fig. 3, Plate 1, at $a\ b\ c$, and that the luminous molecules of which he supposed that ray to consist are thrown off, some outwards, as in the directions a A, b B, c C, d D, and others perhaps inwards, as $a\ \alpha$, $b\ \beta$, $c\ \gamma$, &c.

If the incident light were homogeneous, such as pure red, blue, &c., as found in the spectrum, the colour of the fringes, though differing in intensity from one another, would of course be the same as the incident light; but the sun's light, and most artificial light, being compounds of several simple coloured lights, the fringes in such cases are of various tints, which predominate on their external or internal limits, according as they are differently subject to the causes which produce diffraction.

The experiments of Sir Isaac Newton on the inflexion of light consisted chiefly in making a pencil of light pass between two straight knife-edges inclined to one another in a very acute angle, as in fig. 25, Plate 2. At 4 inches from the point of junction the knives were $\frac{1}{8}$ inch apart. Sunlight was admitted from a source 15 feet off. When the shadows were received on a white screen held close, the fringes were found to run parallel to the knife-edges; but when the receptive screen was moved to some distance these fringes became hyperbolas, as in the figure, crossing one another at different points as the screen was held further off or approached nearer to the knife-edges.

Dr. Young, by a very simple expedient, converted Grimaldi's experiment relative to the light streaks within the shadow of a long rectangular body into the basis of his very beautiful theory of interferences. Let the light at one edge of the body be altogether stopped by an intercepting body placed before or behind the rectangular one, while the light is allowed free passage as before at the other side; the streaks will notwithstanding be instantly obliterated, showing that those streaks are produced by the interference of waves passing on either side of the body, and having their length either equal or differing by a small multiple of the length of an undulation. See fig. 4, Plate 1, where O is the hole, A B the card, E F its shadow, and C D the intercepting body receiving on its margin the margin of the shadow of the edge, B, of the body, and obliterating all the fringes. The illumination of the point X, between E and F, arises from the whole wave a A, b B, minus the portion A B.

Many beautiful optical phenomena arising from diffraction have been produced by transmitting light through one or several small holes, or the interstices of fine wirework, and even by reflection between plane mirrors inclined at a very small angle. Figures of some of these are represented in the Plates. When light is transmitted through

two apertures near each other, rings are formed about each; but, besides, there are narrow straight parallel fringes between them, as seen in fig. 6, Plate 1. If the apertures be unequal, these are hyperbolas, as in fig. 7. M. Fraunhofer has investigated and described a very beautiful class of these optical phenomena. Fig. 8 is a representation of the appearance produced when light is received on the object-glass of the telescope through two small circular holes placed at a distance of 0·03831 inch from each other. When the whole aperture of a telescope is limited by a circular diaphragm, and the aperture reduced to half an inch, the telescope being 7 feet focal length, the disc has the appearance presented in fig. 9. When annular apertures were employed the appearances were extremely interesting. The appearance of Capella was as in fig. 10, and of the double star Castor as in fig. 11. As the breadth of the annulus is diminished the size of the disc and breadth of the rings diminish also. Figs. 12, 13, and 14 show the appearance of Capella with annular apertures of 5·5 inch—5 inch, of 0·7—0·5, of 2·2—2·0. Besides the rings close to the central disc, others larger and fainter are seen. With an aperture composed of two annuli, fig. 15, Plate 2, the phenomenon represented in fig. 16 was seen. When the aperture was in the form of an equilateral triangle, the phenomenon was extremely beautiful, as shown in fig. 17. This is seen when the telescope is in perfect focus, but when thrown a little out of focus, the appearance presented in fig. 18 is shown, in which the different origin of the three secondary rays is apparent, and they are seen to consist of the vertices of the hyperbolas to which they belong. When three circular apertures are used, the image consists of a bright central disc, with six fainter ones, and a system of faint halo-like rings surrounding them, as represented in fig. 19. When three equal and similar annular apertures are thus disposed, the appearance when in focus is as in fig. 10, Plate 1—in fact as if two of the three were closed; but when thrown a little out of focus they produce the effect which fig. 20, Plate 2, represents, when each aperture creates its own central disc and system of rings intersecting; and when nearer to the focus, but not in it, fig. 21 is the appearance seen, the centres gradually approaching and the rings blending, and this continues till fig. 10, Plate 1, appears as the focus is reached. An aperture in the form of the difference between two concentric squares produced not an eight but a four rayed star. These rays were composed of distinct alternating obscure and bright portions, as represented in fig. 22, Plate 2. An aperture consisting of fifty squares, each of about half an inch in the side, regularly arranged at intervals of their own breadth, produced the appearance presented in fig. 23. When the aperture consisted of numerous equilateral triangles regularly disposed, as in fig. 24, the image presented the very beautiful phenomenon shown in fig. 25, which consists of a series of circular discs in six rays diverging from a central one, and each surrounded with a ring. Persons desirous to be further acquainted with these phenomena may consult the memoirs of Young, Fresnel, and Fraunhofer.

DIFFRAC'TION OF SOUND. Just as shown in the preceding article, where light-waves are proved to bend round edges in somewhat the same way as water-waves round a rock, so also is it with waves of sound. An obstacle casts a *sound-shadow*, but the shadow is not perfect. Tyndall in his admirable work on "Sound" (p. 21, fourth edition, 1883) gives a most remarkable example of sound-diffraction, sufficiently recent to be in the minds of some readers. It occurred at the tremendous explosion of a powder magazine which occurred in 1864. "The village of Erith (on the Thames, a little below London) was some miles distant from the magazine, but in nearly all the cases the windows were shattered; and it was noticeable that the windows turned away from the origin of the explosion suffered almost as much as those which faced it. Lead sashes were employed in Erith Church, and these being in some degree flexible enabled the windows to yield to pressure without much fracture of the glass. As the sound-wave reached the church it separated right and left, and for a moment the edifice was clasped by a girdle of intensely compressed air —every window of the church, front and back, being bent *inwards*."

DIFFU'SION OF GASES or of LIQUIDS is their spontaneous intermixture when freely allowed to communicate. Thus two gases, such as hydrogen and carbonic acid gas, though differing enormously in weight, will, if turned into the same vessel, be found after a short time to have become a mechanical even mixture, which so long as it is at rest will not subside into its original parts. Each gas has dissolved the other, so to speak. Rates of diffusion of different gases are measured by a diffusion tube. This is a tube about a foot long, closed at one end with a porous plug and immersed in mercury after being filled with the gas under consideration. The mercury will at once begin to rise in the tube, because the gas is diffusing itself into the air through the porous plug at the other end. It was found by Graham that the diffusion volume of a gas is in inverse ratio to the square root of its density. Taking air as unity this theory would give the diffusion volume of hydrogen (whose density is ·0692) as 3·7994, and actual experiment showed it to be 3·83. The formula is thus extraordinarily close in many instances. The diffusion volume of the heavy carbonic acid gas, with a density of 1·529, is ·812; and that of oxygen, whose density is 1·1056, is ·949. A mixture of two gases in the diffusion tube will be diffused unequally into a third gas outside the tube, each of the mixed gases diffusing according to its own diffusion volume. In this way a separation of a portion of the least diffusible gas may be made, for the more diffusible gas will all have diffused out of the tube while yet some of the other remains.

Liquids suffer diffusion in the same way, as when one liquid in a phial is gently introduced into a bowlful of another. Both will shortly be found to contain a mixture of the two liquids. The colloids, if in solution, diffuse very slowly; the crystalloids are rapid diffusers. [See also DIALYSIS.] If hydrochloric acid be taken to diffuse as 1, then sugar diffuses as 7, albumen (a colloid) as 47, &c.

DIFFUSION OF LIGHT and HEAT is that irregular scattering of light-rays or of heat-rays which occurs when reflection takes place; for besides the great mass of the ray which is reflected at an angle equal to that of its incidence, the remainder is scattered in all directions. A looking-glass will often look black, for very little light is left for diffusion, almost all having been reflected; but a piece of paper will look brilliantly white, since it diffuses or scatters far more light than it reflects. It is by diffused light that we perceive the forms of objects. See remarks in the article COLOUR.

DIGAM'MA or **VAU** is the name given by grammarians to a letter which once belonged to the Greek alphabet. It appears to have occupied the sixth place in that alphabet, for while *epsilon* is employed as the numerical symbol for *five*, the next letter, as that alphabet is now arranged, is the representative of *seven*. Moreover, this position of the digamma corresponds with that of *vau* or *waf* of the Hebrew, and of *f* in the Latin alphabet, two letters of kindred power and form. The letter is still seen in many inscriptions. With regard to the power of the letter, it is now the general and well-established opinion that it is equivalent to our own *w*.

The use of the digamma prevailed more particularly in the Æolic dialect of the Greek tongue. In the other dialects it was commonly dropped, particularly in the Attic; and, as

this became the favourite dialect of Grecian literature, the digamma at last escaped from the alphabet, and even the Homeric poems, which had been composed in a dialect still possessing the digamma, were presented to the Athenians without that letter, to the serious injury of the metre. But though the form of the digamma was not admitted into the Attic alphabet, the vowel *o* was occasionally used so as virtually to represent it, as in *οἶδα*, *οἶκος*, *οἶνος*, equivalent to ϜΙΔΑ, ϜΙΚΟΣ, ϜΙΝΟΣ (compare the Latin *video*, *vicus*, *vinum*); and it was quite superfluous to prefix the digamma (ϜΟΙΚΟΣ), as was sometimes done. The digamma (double gamma) gets its name from its form (Ϝ), which resembles two gammas (Γ) placed one above the other.

The Latin language, being more closely connected with the Æolic dialect of the Greek, abounds in the use of this letter; for the true pronunciation of the *v* or *u consonans* must have been the same as our *w*, or it could not have so readily interchanged with the vowel *u*. The Greek words *ᾠόν*, *ἔαρ*, *ἑσπέρος*, *Ἑστία*, *ἴον*, appear in Latin as *ovum*, *vēr*, *vesperus*, *vesta*, *viola*. Sometimes a *b* appears in the Latin word where the Æolic Greek must have had the digamma, as *probus* compared with *πρᾳΰς*.

DIGBY, SIR EVERARD, was born in 1581, of an ancient, honourable, and wealthy family of Gatehurst, Bucks. He was converted to Roman Catholicism, and is chiefly known from his connection with the Gunpowder Plot, which he assisted with £1500 in money. He joined Sir Francis Tresham and others in a sham hunting party, which was in reality an armed rising, and waited only the success of the plot. When this failed the party was broken up, and Digby and the others were separately hunted down and taken. At his trial he pleaded guilty, and was executed 30th January, 1606.

DIGBY, SIR KENELME, the son of Sir Everard Digby, was born in 1603. He was educated as a Protestant, and sent to Oxford at the age of fifteen. He was knighted in 1623. Under Charles I. he became a gentleman of the bedchamber, a commissioner of the navy, and a governor of the Trinity House. In 1628 he equipped at his own expense a squadron, with which he sailed first against the Algerians and afterwards against the Venetians, who had some dispute with the English. In 1636 he went to France, and became a convert to the Roman Catholic religion. He returned to England in 1638, and was imprisoned as a royalist on the breaking out of the Civil War, but was at length suffered to retire to France. Sir Kenelme travelled about France and Italy during this time, but in 1655 he was allowed by the Protector to return to England. He died in 1665.

Sir Kenelme Digby, though he fell into the errors of philosophy and many of the wild dreams which were common in his day, was certainly possessed of no ordinary talents. The following is a list of his extremely curious and entertaining writings:—"A Conference with a Lady about the Choice of a Religion" (Paris, 1638); "Letters between Lord George Digby and Sir Kenelme Digby concerning Religion" (London, 1651); "Observations on Religio Medici" (London, 1643); "Observations on part of Spenser's Faerie Queene" (London, 1644); "Treatise on the Nature of Bodies" (Paris, 1644); "A Treatise on the Soul, Proving its Immortality" (Paris, 1644); "Five Books of Peripatetick Institutions" (Paris, 1651); "A Treatise of Adhering to God" (London, 1654); "Of the Cure of Wounds by the Powder of Sympathy" (London, 1658); "Discourse on Vegetation" (London, 1661).

DI'GEST is the name of one of the three great divisions of Justinian's legislation. The CODE was a collection of the "constitutions," or laws by proclamation, of the emperors; the INSTITUTES contained an elementary treatise on the principles of the civil law; and the Digest (or Pandects) was a collection of commentaries from all the great jurists. It was called Digest because it professed to be *Legalia præcepta excellenter digesta*; and that of Pandects from *Pandekton* (Gr., all-comprehensive). Tribonianus, who had been chief in the preparation of the Code of Justinian, was set over the commission of seventeen. They worked on the Digest from A.D. 530 to 533, arranging the great legal treatises of thirty-nine famous Roman jurists under selected "titles," divided into fifty books, and forming a well-arranged mass of exposition and interpretation of the ancient laws of Rome, itself at once taking rank as a body of law. The Digest formed the basis of all mediæval law. Godefroi is the standard modern commentator on the Digest, but a very useful volume was published by the University of Oxford in 1883, containing thirty-two "Select Titles from the Digest of Justinian," edited by Thomas Erskine, Holland, and C. L. Shadwell. Some judges prefer the excellent stereotyped Berlin "Corpus Juris Civilis" (Berlin, 1877) by Krüger, in two vols. 4to, which gives useful notices of variations from the Florentine MS., and from ante-Justinian jurists, whose works are preserved elsewhere than in Tribonian's Digest; it has also the merit of being complete. The Oxford book gives, however, useful analytic tables of contents.

DIGEST'ER, a strong steam-tight vessel, made usually of copper or iron, in which water, &c., can be heated considerably beyond the boiling-point. It was invented by Papin, a French physician, who visited England in 1680, and while here became a fellow of the Royal Society and a friend of the celebrated Boyle, and published his account of "The New Digester, or Engine for the Softening of Bones." Dr. Papin's chief motive for the invention was the extraction of gelatine from the bones, which is much more easily dissolved by superheated water than by boiling water. It is found, however, that no pressure, however great, will keep water liquid over the temperature of 773° Fahr. A suitable apparatus records the pressure in the digester, and a pressure of twelve atmospheres (180 lbs. to the square inch) is found to raise water to 374° Fahr.

DIGES'TION, the process by which the food is converted into nutriment. Taken in its whole extent, the process of digestion comprehends the entire series of changes by which the crude aliment is assimilated into arterial blood. These changes are effected by organs which, viewed collectively, comprise a most extensive apparatus, commencing at the mouth and ending at the lungs.

The first changes upon the food, in man, are effected in the mouth, where it is mixed with saliva. This fluid prepares the food for the further changes it has to undergo in digestion. The saliva varies considerably in specific gravity, being always denser after a meal than during fasting. Healthy saliva has mostly the specific gravity of 1007·9, and it is either alkaline or neutral, generally the former, and contains an organic matter termed ptyalin, as well as sulphocyanide of potassium, neither of which substances occurs in any other solid or fluid of the body. The uses of the saliva, in reference to digestion, are partly mechanical and partly chemical. The mechanical uses are the moistening of the dry food for the double purpose of adapting it for deglutition and of separating the particles, and thus allowing them to be acted on more freely by the other digestive fluids. The great chemical use is to convert the amylaceous (or starchy) portion of the food into glucose or grape-sugar, thus promoting its absorption. The average weight of saliva secreted in twenty-four hours (by far the greater part being secreted during active digestion) is from 1 to 2 lbs.

The food being formed into a moist bolus by the grinding of the teeth and incorporation with the saliva, receives a further and more viscid secretion of saliva from the gland beneath the tongue, coated with which, when it is seized by the muscles of the throat (pharynx), it slides easily downwards, receiving a further and yet more viscid secretion from the spongy bodies called the tonsils, as it passes

them. The first act in deglutition is voluntary, but is often performed unconsciously. The tongue presses the bolus of food against the palate, and so squeezes it back to the opening of the pharynx. The deglutition of the pharynx and of the œsophagus are quite involuntary, as may be felt on passing a feather into the throat and experiencing the firm pull which it receives as the muscles seek to push it downwards. The pharynx has not only to pass the food onwards into the gullet (œsophagus), but to guard against it entering the nose on the one hand and the windpipe (larynx) on the other, since both the posterior orifices of the nose and the larynx open into the pharynx. This is accomplished by both pharynx and larynx rising together to receive the food; and the latter, being covered by the back part of the root of the tongue, which is retracted and pushes the food before it, is also protected by a constriction of its own, and by the epiglottis, which falls down over its orifice like a lid; while the opening of the back of the nasal cavity is protected from the intrusion of food by the soft palate bedding firmly against the back of the pharynx. The food once in the grasp of the pharynx is quickly pushed into the œsophagus, which with an undulatory constrictive motion, somewhat like that of the intestines, passes the food onwards into the stomach. Thus it is that a man can eat and even drink quite securely when standing on his head, a feat not seldom resorted to in the mirth of country fairs. It becomes less wonderful when we consider that horses and other such animals *always* drink in this manner.

The human stomach is a pouch-like dilatation of the alimentary canal, whose shape is well shown in the Plate (where it is accompanied by drawings of the widely differing stomachs of other animals), and its average capacity is about 5 pints. But it can be greatly distended, and also when inactive contracts largely. Its office is to convert the food into CHYME, and this it does by its muscular power and by its special secretion of the gastric juice. The stomach and the intestines in man have three coats, the external peritoneal coat (an ordinary serous membrane), the muscular coat, and the innermost mucous coat in two layers. The layers of the muscular coat of the stomach are composed of fibres lying in different directions—across, along, and oblique, so that the stomach can be contracted in every direction, and by suitably successive contractions the food may be made to revolve in the stomach as milk in a churn, both orifices of the stomach being firmly closed. When the stomach is empty the lining of mucous membrane wrinkles up into folds, and is pale and slightly coated with mucus. But as soon as food is introduced and the stomach is distended the wrinkles disappear, the flow of blood is very great, the mucous coat becomes deep red, and the gastric glands imbedded in it secreting actively. As much as 20 pints a day of gastric juice are secreted sometimes, but the average lies between 10 and 20 for a healthy man.

The composition of the gastric juice in man and in a sheep are:—Man—water, 994·4; solids, 5·6: sheep—water, 986·15; solids, 13·85. And the solids are thus composed:—

	Man.		Sheep.
Ferment, ...	3·19	...	4·20
Hydrochloric acid, ...	·20	...	1·55
Chlorides of calcium, of sodium, and of potassium, ...	2·09	...	6·01
Phosphate of calcium, magnesium, and iron, ...	·12	...	2·09
	5·6	...	13·85

The hydrochloric acid, constituting an essential ingredient of the gastric juice, is conceived to be derived by an act of secretion from common salt (chloride of sodium) contained in the blood. The alkali, the base of the salt, is retained in the blood to maintain the alkaline condition essential to its healthy constitution, while the acid is liberated and poured in the gastric juice into the stomach to accomplish the solution of the food.

Gastric (or stomachic) digestion, or the conversion of food into chyme, depends upon the action of this acid and the powerful ferment called pepsin, which together convert ordinary proteids or nitrogenous substances into peptones. Peptones differ remarkably from proteids: they are readily amenable to DIALYSIS, having acquired crystalloid properties in that particular, so that albumen, which in its original state would be indigestible, because it could not pass through the fine membranes of the coats of the digestive organs, is able after gastric digestion to pass quite freely. They are also not precipitable by heat, acid, &c.; they are powerfully antiseptic, and finally they are very soluble in water and in neutral solutions of salts. Meat, eggs, milk, the gluten of bread, &c., all become peptones; milk is curdled and then dissolved; gelatin is dissolved; mucin and horny tissues, however, pass untouched. Starches and fats are not digested in the stomach. Salt, if not decomposed by the saliva, readily yields to the gastric juice; sugar is dissolved but not decomposed. The antiseptic qualities of the gastric and intestinal juices enable us to eat game, &c., with impunity, even in what to some persons is a somewhat disgusting stage of incipient decay. Chymification takes on the average, for a mixed meal, three or four hours—the nature and quantity of the food greatly modifying this, however.

In the Plate there are also some other typical stomachs shown—those of a sheep, fowl, &c. The stomach of the pig much resembles that of man, a fact which when stated in reverse order tempts sometimes towards a feeble joke; that of the kangaroo seems to be simply doubled; but that of a ruminant (sheep, ox, &c.) is very different. Here we see four cavities: 1, the paunch (rumen), a large cavity at the cardiac (heart) end, into which the grass, &c., is thrust half chewed; 2, the honeycomb (reticulum), so called from its surface being dimpled with roughly hexagonal pits, which probably moistens the food delivered to it by the paunch. In the camel much water is retained in the extremely deep depressions of the second stomach, enabling the animal to exist in the desert, &c., for many days without drinking. From the reticulum the food is regurgitated into the mouth in a bolus, or cud, which the animal slowly chews until it is completely insalivated, when it is swallowed and passed, not into the paunch, but along a deep groove, the lips of which now close to form a tube leading into the *third* stomach, the maniplies (psalterium or omasum). The mucous membrane of the third stomach is arranged in thick longitudinal folds, so that a large surface is packed into small compass. After undergoing certain not well-ascertained changes in the psalterium, the food finally reaches, 4, the reed or rennet, the true stomach (abomasum), narrow and elongated, with a much more vascular mucous membrane, secreting the gastric juice, and fulfilling the function of true gastric digestion.

The function of mastication is performed in birds by the stomach, the gizzard receiving the stored and soaked contents of the crop, and grinding them between its powerful muscular walls with their dense horny epithelium, aided too by small stony particles, which the bird takes care to swallow from time to time. The dilatation of the tube before the gizzard, called the second stomach, provides the gastric juice in birds (see Plate).

A very curious question arises, "Why does not the stomach digest itself?" especially, also, as in physiological experiments it is frequently found that a part of the stomach and intestine has actually been dissolved after death, if the animal has been kept a few hours before being opened. Dr. Hunter first drew attention to this

"post-mortem digestion," and explained it by saying that the "vital principle" preserved the stomach during life—an explanation exactly equal to the celebrated definition of an archdeacon by Sydney Smith as "a person who performs archidiaconal functions," in its power to convey no information. Bernard thought the mucus, constantly renewed during life, shielded the stomach, but Pavy cut it away during life in some dogs, and yet found at death no digestion of the exposed surface to have taken place, though ten days had elapsed. Pavy holds the alkalinity of the blood to be sufficient to counteract the acidity of the gastric juice; and perhaps after further investigation this view may prove the right one.

The food, then, as chyme, presses against the pyloric orifice of the stomach, and as it is digested is passed into the small intestine. This in man is about 20 feet long, and is classified into the *duodenum* (10 inches), the *jejunum* (8 feet), and the *ileum* (11½ feet). It terminates in the CÆCUM, and passes its contents through the ileo-cæcal valve in the side of the cæcum into the large intestine. The latter is about 6 feet long; the whole intestine is therefore about five times the length of the entire body. In carnivores it is much shorter, in blood-sucking bats it is almost straight, in lions it is but thrice the length of the body; in herbivores, on the other hand, it is very long, the sheep having intestines from twenty-eight to thirty times the length of the body. When the food passes into the small intestines but very little of it has been absorbed, though much is ready for absorption; direct entrance from the stomach into the body being only positively ascertained for salts, simple water, &c., which pass through the walls of the capillaries, and so by the veins to the liver. This direct progress is much relied upon in the administration of medicines to affect the liver.

The general structure of the small intestine is the same as that of the stomach, and its muscular action as powerful. It pushes the food onwards in successive vermiform contractions, by what is called the peristaltic action of its muscular coat. Its mucous coat is a more complex structure, however, than that of the stomach. This coat is folded in ridges transverse to the length of the intestine (*valvulæ conniventes*), so as to expose as large a surface as possible, and these ridges do not disappear (like those of the stomach) on distension. They further probably serve the purpose of delaying during absorption the more liquid parts of the chyme, which otherwise might flow too rapidly through the canal. They cease near the middle of the ileum. The whole mucous membrane of the small intestine is covered with *villi*, minute vascular processes from a quarter of a line to 1¾ line in length, giving the inner surface of the intestine a velvety appearance. They lie thicker at the upper part of the intestine, where from fifty to ninety are found in a "square line"—lower down there are from forty to seventy in the same area. (A line is the twelfth part of an inch.) Their function is ABSORPTION, and the LACTEALS which they contain suck out nourishment (chyle) for the body from the chyme in the manner described in the articles under those headings.

The intestinal fluid or juice (*succus entericus*) is the special contribution towards digestion of the intestines. Three kinds of glands (which will be found described in more detail under the article INTESTINES) supply this fluid, whereof Brunner's glands are confined to the region of the duodenum in the small intestine, Peyer's glands or patches to the whole course of the small intestine, and Lieberkuhn's glands extend throughout the whole intestinal canal. The constitution and effect of the intestinal fluid are most difficult to determine, since it is next to impossible to isolate these secretions; but the general opinion is that the fluid of Brunner's glands rather resembles gastric juice in its action (turning proteids to peptones), and that of Lieberkuhn's rather resembles saliva (turning starch to sugar). The subject, however, awaits the genius of some new discoverer.

But besides the intestinal fluid, the chyme receives almost as soon as it leaves the stomach two important secretions, the pancreatic juice (see PANCREAS) and the BILE, both fully described elsewhere. These enter the small intestine by a common duct, into which the pancreas and the liver respectively pour them. The action of the pancreatic juice is most important. It completes the action of the saliva in converting the yet remaining starches into sugar, an action which the stomach has checked for a while; and also that of the gastric juice in turning proteids into peptones; and further, it breaks up and converts into an emulsion the oils and fats on which neither the saliva nor the gastric juice has had any power. The last function being special to the pancreas is naturally regarded as most important, because although its secretion is largely concerned in the digestion of proteids and starches, yet they may on emergency be rendered soluble and absorbable by the other digestive fluids; but if the pancreas be out of order the fats pass through the alimentary canal untouched, and are thrust out undigested with the fæces. At the same time recent experiments show clearly that the bile assists in this important part of digestion, the emulsifying of the fats. Further uses of bile in digestion seem to be—1, a peculiar property it has of stimulating the villi of the intestine to their office of absorption, and facilitating the OSMOSIS of the chyle; 2, a strongly antiseptic action, equal in its power of arresting decomposition to that of the gastric juice; 3, an irritating, stimulating action upon the intestinal glands, causing them to secrete freely. Hence it is easy to explain the obstinate constipation so characteristic of a sluggish liver. (The functions of the LIVER as an excretory organ, eliminating from the blood poisonous and other injurious substances almost as soon as they are absorbed, are elsewhere spoken of. Bile as a digestive, and not in its equally important character of an excrement, here alone concerns us.)

Passing in review what has been said above we find that the five great divisions of food (for details of which classification see DIET, FOOD) are thus digested:—

Proteids are changed to peptones and dissolved partly by the gastric juice in the stomach, and finally by the pancreatic juice and fluid of Brunner's glands in the intestines; and are absorbed partly by the bloodvessels, chiefly by the lacteals, of the small intestine.

Starches are changed to sugars (and dextrin, &c.) and dissolved partly in the mouth by the saliva, finally in the intestine by the pancreatic juice and the fluid of Lieberkuhn's glands; and absorbed chiefly by the bloodvessels of the intestines, partly also by those of the stomach.

Fats are broken down and rendered soluble in the upper part of the small intestine by the pancreatic juice, assisted by the bile, and it is the emulsion thus formed which gives the milky aspect to the chyle, and hence to the lacteals (Lat. *lac*, *lactis*, milk) which absorb it. At the same time a small part of the fats becomes saponified, and this part is absorbed by the bloodvessels.

Salts (including sugars) are dissolved by the saliva or by the fluids drunk at meals, and are at once absorbed by the bloodvessels of the stomach.

Liquids, like salts, pass almost at once into the blood, being already by their nature highly absorbable; if, however, the bloodvessels of the stomach should have passed them by, they are taken up by those of the small intestine immediately they enter it. The objection at once occurs that the contents of the intestine would run a risk of rapidly becoming solid and not passing along easily; but the considerable flow of the pancreatic juice and bile and of the intestinal fluids maintains the fluidity of the chyme. By the time this reaches the end of the small intestines,

passing from the ileum into the CÆCUM by the ileo-cæcal valve, it has acquired the characteristic odour and brownish-yellow colour of fæcal matter—the first being due to the chemical formation of a principle called *indol*, from the decomposition of the proteids; the second, to the colouring matter of the bile.

The chyme leaves the stomach distinctly acid in character, but the acidity is soon neutralized by the decided alkalinity of all the post-gastric secretions, and during the remainder of its passage through the small intestine it is first neutral, then alkaline. When, however, it collects in the large intestine it moves very much slower, and again becomes acid, in all probability in consequence of fermentation during the comparative stagnation it undergoes in the cæcum. The passage of an ordinary meal through the 20 feet of the small intestine occupies twelve hours, while through the 6 feet of the large intestine it takes from twenty-four to thirty-six. It is just, however, to add that this rate of progress, though stated upon the best authority, is not universally agreed to.

The large intestine contains no villi, and its absorptive power therefore lies chiefly in the bloodvessels. As a consequence the fæces become drained of their liquid, and finally, in the healthy state, become somewhat firm. About half a pound of fæcal matter is daily evacuated by a healthy man; but of this (under our present universal habit of over-feeding) much is practically undigested food. The fæcal residuum of a truly abstemious man, such as was CORNARO, would be extremely small, as no more nutriment is supplied to the body than what is required to repair its daily waste.

For the manner in which the digested products of the food are taken into the body, see CHYLE, LACTEALS, LYMPHATICS, ABSORPTION.

DIGES'TION, in chemistry, is the exposure of any substance to partial or total solution in a fluid aided by a gentle heat.

DIG'IT (Lat. *digitus*, a finger), a term employed to signify any symbol of number from 0 to 9. According to the original application of the term, the first ten numbers should be called digits, but universal practice employs the word to signify the ten symbols used in reckoning numbers. Thus ten (10) is a number of two digits.

DIGITA'LIN, the active principle of the foxglove (*Digitalis purpurea*). It is usually extracted from the aqueous solution of the plant by precipitation with tannin. The precipitate is decomposed by oxide of lead, and the digitalin crystallized by solution in ether or alcohol. It is a white, crystalline, inodorous powder, with a bitter taste, almost insoluble in water, but soluble in alcohol and ether. It is also soluble in sulphuric acid, the solution becoming crimson. Digitalin is very poisonous, with a special action on the heart. It produces intolerably violent sneezing. The formula is $C_{54}N_{90}O_{30}$.

DIGITA'LIS. See FOXGLOVE.

DIGITA'RIA, a genus of GRASSES belonging to the tribe Paniceæ. This genus has obtained its name from the singular form of its spikes of flowers, which look like fingers (Lat. *digitus*, a finger). *Digitaria sanguinalis* is a common plant in Germany. It abounds by the roadside in Poland and Lithuania, in which countries its seeds are collected and boiled whole with milk, like rice, and it is esteemed a pleasant article of diet. *Digitaria humifusa* is a rare plant. It is a native of many parts of England and grows in sandy fields.

DIG'ITIGRADE is a term applied to those families of the Carnivora which walk on the tips of their toes, the heel being raised above the ground. The group exhibiting this character in the greatest perfection is the Felidæ. Some groups, as the Viverridæ, exhibit a transition between the digitigrade structure and the plantigrade, which obtains in the Ursidæ.

DIGITO'RIUM is the name given to a "dumb" key-board. A digitorium consists of a few pianoforte keys (five or more) suitably weighted with springs, &c., and giving an opportunity to a student of keyed instruments of practising the absolutely necessary "five-finger exercises," to strengthen the muscles of the fingers, while freeing him from the tiring and even distressing monotony of sound with which similar practice on an ordinary instrument annoys the sensitive ear. Besides, any smaller variety of the digitorium can be carried in a large pocket and used at any interval of leisure. The greatest pianoforte virtuoso who has ever existed (Liszt) always used a similar mechanism while travelling on concert tours, or during conversation; and doubtless to this incessant work (carried on without the slightest mental fatigue) his unequalled strength and flexibility of finger is largely attributable.

DIJON, the capital formerly of the duchy of Burgundy, and now of the department of Côte d'Or, in France, stands on the left bank of the Ouche, a feeder of the Saône, 195 miles S.E. from Paris by railway, and had 55,453 inhabitants in 1881. It existed during the Roman dominion under the name of *Dibio*. From the Romans it passed, in the fifth century, to the Burgundians, and subsequently to the Franks. Under the Carlovingian princes Dijon was a lordship of the bishops of Langres, who often resided here. In the ninth century it was under counts of its own, who held it of the bishops as suzerains. In the eleventh century the lordship of Dijon was united to the duchy of Burgundy. The dukes of Burgundy usually resided here; and when Louis XI. of France took possession of Burgundy, and established the provincial Parliament, he fixed its sittings in this town.

Dijon is situated in a plain on the eastern side of the Côte d'Or Hills. It is surrounded by walls and ramparts, which are planted with fine trees. The town is entered by five gates; it is traversed from north to south by the Suzon, which flows in a channel formed under the streets, and joins the Ouche close to the ramparts. The streets are well built, clean, and cheerful. The houses, which are of freestone, are only of one or two storeys. Of the public buildings the most important are—the cathedral, dedicated to St. Benigne, which dates from 1291, and is surmounted by a spire 330 feet high; the churches of Notre Dame and St. Michel; the palace of the states of Burgundy, which is surmounted by a lofty tower, now used as an observatory, and contains museums of painting, sculpture, antiquities, and natural history, and also a library of 40,000 volumes; the court-house; the theatre, which is built after the model of that of Bordeaux; the residence of the prefect of the department; the town-house; and the general hospital.

The manufactures of Dijon are woollen cloth, hosiery, blankets, woollen and cotton yarn, leather, vinegar, mustard, and starch; there are also brandy distilleries, salt refineries, and breweries. A large trade is carried on in corn, flour, the excellent wine of the Côte d'Or, wool, hemp, and wax candles. Dijon is well situated for trade at the junction of several roads; the Canal de Bourgogne passes along the valley, close to the town, and there is good railway accommodation. Dijon is the seat of a bishop, whose see is co-extensive with the department of Côte d'Or. It is also the seat of a university academy, and of a high court which has jurisdiction over the departments of Côte d'Or, Haute Marne, and Saône-et-Loire.

Few cities in France can vie with Dijon in beauty of site, or in the number and variety of its promenades, which form a belt of foliage about the town. Among the latter are the ramparts, which afford a fine view of the town and the surrounding country; the Chemins Couverts; the Allèes-de-la-Retraite, on the east side of the town, formed by four rows of noble lime trees; the Creux d'Enfer and Fontaine Suisse, two beautiful fountains surrounded by fine plantations; the Promenade de l'Arquebuse; and above

all the Cours du Parc, which is nearly a mile in length, divided midway by a spacious circle, and leads to the great park on the banks of the Ouche.

Dijon was attacked by the Germans under General Boyer, 30th October, 1870, and the heights and suburbs having been seized by Prince William of Baden, the town surrendered on the 31st. The place was subsequently held by General Werder, the conqueror of Strasbourg, who evacuated it in January, 1871, and fell back on the lines around Belfort, on the approach of the disastrous expedition under General Bourbaki. The town was at once occupied by the forces under Garibaldi. When Manteuffel was afterwards despatched in pursuit of Bourbaki, he left a detachment near Dijon to hold Garibaldi in check; and a series of engagements took place in the vicinity, wherein the German strategy caused Garibaldi to imagine, and led him to boast, that he had obtained a considerable victory. The news which presently arrived of Bourbaki's misfortunes showed Garibaldi that he had been effectually hoodwinked. He at once retired from Dijon to a part of France protected by the armistice which ensued, and the town was once more entered by the Germans, who retained possession till the payment of the indemnity in 1873.

Bossuet, Jacques Cazotte, the elder Crébillon, Daubenton, Jouffroy, Longpierre, Bernard de la Monnoie, Guyton de Morveau, Piron, Rameau, and Saumaise were natives of Dijon.

DILEM'MA, in argument, a position in which there are two conclusions adverse to your opponent, one or other of which he must admit. For example, when in the ancient jest a man of Crete said in his haste "all Cretans are liars," he would be quickly put in this dilemma:—Either you are a liar being a Cretan, and hence your remark is probably a lie, or if you do speak truly all Cretans are *not* liars, since you are an exception to your own rule. In either case the statement is a false one. The two propositions are usually called the "horns of a dilemma."

DIL'IGENCE, in the law of Scotland, is an expression nearly equivalent to *execution* in the law of England. It includes the various means by which the person may be seized and imprisoned, or the property attached and disposed of, to the end of enforcing payment of a debt or performance of any civil obligation. It means the warrant of a court to enforce attendance of witnesses or production of writings, corresponding in this sense to the English term subpœna. In a general sense the word refers to the care which the law requires every one to bestow on the subject of a contract.

DILL (*Peucedanum graveolens*) is an aromatic plant whose fruit is employed medicinally as a useful carminative. It is a biennial, and a native of the Mediterranean region and the Cape of Good Hope. The fruits (commonly called "seeds") and the plant itself are used in the East as condiments, and it is supposed to be the anise of the Bible.

DILLENIA'CEÆ, an order of plants belonging to the POLYPETALÆ. They are chiefly Asiatic trees or shrubs, and usually yellow flowered. A few occur in America. The trees are found in the woods of tropical India; the bushes inhabit Australia, especially in the more temperate parts, and China; the woods of Brazil contain several kinds, usually climbers or having a trailing habit. They appear to possess astringent properties, but nothing else of importance.

The species in cultivation in this country are almost all Australasian, and have something of the appearance of yellow-flowered cistuses. Among these occur species of the curious genus Pleurandra, in which the stamens are developed on one side only of the flower, all those on the opposite side being abortive. There are few analogies to this in the vegetable kingdom. *Hibbertia volubilis* is a showy twiner, but its flowers are intolerably offensive in their smell, and it is therefore not much cultivated.

This order belongs to Bentham and Hooker's cohort Ranales, and is distinguished by the sepals being five, herbaceous, persistent; the petals five or fewer, deciduous; numerous stamens, the anthers dehiscing by lateral chinks or terminal pores; the pistil is free, composed of one or several carpels, which are free or, rarely, cohere in the centre of the flower.

DIL'UENTS comprise those liquids which are used to dilute the fluids of the human body, and thereby modify their nature. They are employed when the secretions are too viscid, or the contents of the stomach, of the intestines, or any of the glands are too acrid, and also when the heat of the body, as indicated by thirst, &c., is too great and causes a feeling of uneasiness.

Water is the simplest and often the best diluent, but it may be rendered more agreeable in some cases by being made into toast water, or by the addition of a little vegetable acid. Mucilaginous drinks, such as barley water or linseed tea, also form excellent diluents, and from their action on the mouth and throat serve to quench a feverish thirst more effectually than water alone.

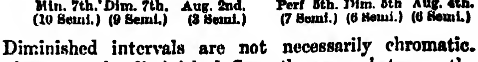
DILU'VIUM, a name formerly applied to the lower division of the Post-tertiary or Quaternary deposits. It corresponds to what is now better known as PLEISTOCENE, or Post-pliocene.

DIME is a coin of the United States. Its value is the tenth part of a dollar, but it is little used in commercial life. See some remarks upon the dime in DECIMAL SYSTEM.

DIMEN'SION, in algebra, a term which is used in the same sense as *degree*. Thus x^2y is of three dimensions, or of the third degree. In geometry length is of one dimension, surface of two, and solidity of three. Thus geometry of three dimensions means solid geometry. Geometricians now plead for the usefulness of a purely theoretical "space of four dimensions," a conception which it is sufficient to state to show that it is one quite unthinkable by ordinary minds. As much study has been given by the finest intellects to its elaboration, however, it seems necessary to allude to it here. In the discussions attending the presidential address of Mr. Spottiswoode to the British Association in 1882, which dealt with this and kindred mathematical speculations, the "fourth dimension" of the imaginary space described by that gifted mathematician was half jocularly termed the "inside-out dimension." The subject is too abstruse for dealing with here, but the essay referred to will give sufficient information to any student desiring a cursory view of this extraordinary hypothesis.

DIMINISHED INTERVALS, in music, are those which are a semitone less than minor or than perfect. Thus C to B♭ (see illustration) is a minor Seventh; C♯ to B♭ is a diminished Seventh. E to B is a perfect Fifth; E to B♭ is a diminished Fifth, &c.

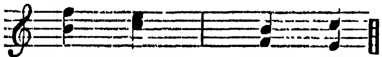
In the inversion of intervals (wherein the lowest note of the interval is taken an octave higher) diminished intervals become augmented. Thus a Seventh always inverts into a Second, a Fifth into a Fourth, &c.; and the diminished Seventh inverts into an augmented Second, &c.



Min. 7th. (10 Semi.) Dim. 7th. (9 Semi.) Aug. 2nd. (3 Semi.) Perf 5th. (7 Semi.) Dim. 5th (6 Semi.) Aug. 4th. (6 Semi.)

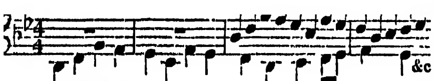
Diminished intervals are not necessarily chromatic. For instance, the diminished Seventh occurs between the Second and the Seventh of every minor scale, the illustration above being that occurring in the scale of D minor; the diminished Fifth occurs between the Seventh and the Fourth (in the next octave above) of every major and minor scale, our illustration holding good for F major and F minor. Also, there is a diminished Fifth between the

Second and Sixth of the minor scale, our illustration in that case holding good for D minor. All the intervals just named are strictly diatonic, although they may require inflection by flat or sharp. Diminished intervals are always discords, and always resolve upon a smaller interval. The diminished Seventh resolves into a Sixth or a Fifth, &c.; the diminished Fifth into a Fourth or a Third, &c. The opposite is the case with the resolution of augmented intervals, which always resolve into larger intervals. This difference is most sharply marked in the interval of the tritone (say B–F, or F–B), which is either an augmented Fourth or a diminished Fifth, according to which letter is taken as the bass. But although the intervals are identical in size (six semitones) their resolutions differ in the manner above stated, the augmented Fourth enlarging to its resolution and the diminishing Fifth contracting. See also DISCORDS.



Dim. 5th. (6 Semi.) Resolution. Aug. 4th. (6 Semi.) Resolution.

DIMINU'TION, in music, is the converse of AUGMENTATION. A subject of a fugue, &c., being given out in notes of a certain length, is said to be taken in diminution when it is repeated in notes of half that length. Diminution is a favourite device in the stretto of a fugue, or at the close of such a piece, as it gives a sense of hurrying onward, crowding together the interest of the work in a quick brilliant manner, obtainable by no other means equally simple. In this case the diminution is taken against the original subject, and care must be used not to begin the diminution too soon lest it should catch up and pass by the slowly-moving subject. We append an example of diminution.



Subject.

DIM'ITY, a cotton stuff, similar in fabric to fustian, from which it differs chiefly in having ornaments woven in it. In the weaving longitudinal stripes are usually raised just above the surface of the piece—hence *dimities* are called single, corded, or broad-striped according to the flatness and breadth of these stripes. The fact of its having been a manufacture of Damietta, in Egypt, is said to have originated the name.

DIMORPH'ISM, in botany, is a term used to denote a condition of certain plants, when individuals belonging to the same species have two forms of flowers, differing in the relative position or length of the anthers and stigma. For instance, if primroses or cowslips be examined, some will be found with the stigma half-way down the tube and the anthers at the top (see Plate I., BOTANY, fig. 7), while others have the stigma reaching to the top of the tube and the anthers half-way down. Darwin gave the true explanation of this:—An insect visiting a long-styled flower would get its proboscis dusted with pollen at a part which, on its going to a short-styled form, would come just opposite the stigma, and deposit some of the pollen. This is a provision for cross-fertilization which, according to Darwin's experiments, is so advantageous in producing a larger number of seeds and finer seedlings.

DIMORPHISM, in Crystallography, is applied to substances crystallizing in two different forms. The most commonly known instances are carbon, as the diamond monometric and as graphite hexagonal. Other elements also crystallize in these two forms—sulphur in rhombic octohedrons and rhombic prisms. Many compounds are dimorphous, as carbonate of calcium, as aragonite, and as calcspar; many of the sulphates, potassium nitrate, and iodide, and several of the sulphides and oxides of the metals. The most remarkable substance is the red iodide of mercury, which is known in scarlet tables belonging to the dimetric system, but which sublimes in yellow rhombic tables. The colour is retained on cooling, but on scratching the mass with a pin the crystals at once change into the brilliant scarlet form. Some crystalline substances have also amorphous forms, as sulphur and phosphorus. Barley-sugar and sugar-candy are common illustrations of these two forms. The change from the amorphous state is often accompanied by evolution of heat, as when melted barley-sugar is rapidly pulled out it becomes very hot, and is converted into pulled sugar, obtained in white crystalline sticks.

DINAN, a town of France, in the department of Côtes-du-Nord, 14 miles S. of St Malo, stands on a steep hill on the left bank of the Rance. It has a tidal harbour for vessels of 150 tons, a tribunal of first instance, ecclesiastical and communal colleges, and 8000 inhabitants. The town, which stands in the midst of most beautiful scenery, is surrounded by walls and entered by four gates. It is irregularly laid out; the houses are chiefly built of wood and afford many curious illustrations of old architecture. The Church of St. Sauveur, an interesting edifice in the Romanesque style, the Church of St. Malo, the old citadel, often inhabited by Anne of Brittany, and the gates of the town are the most remarkable structures. Sailcloth, linen, calico, woollens, leather, pottery, and sugar are made; there is also an active trade in timber, planks, seeds, slates, Norway deals, salt, &c., by the Canal de l'Ille-et-Rance. Dinan is much frequented for its mineral waters. The banks of the Rance are most picturesque. The village of Corseult, a few miles distant, stands on the site of the ancient *Curiosolitæ*, where Roman remains are often found.

DINANT, a town of Belgium, in the province and 15 miles S. of Namur, is situated on the Maas. It has a population of 6500, a cathedral, two hospitals, and a Latin school, and manufactures of hardwares, woollen, cloth, leather, paper, and hats. It is very romantically situated, and is often visited owing to the attractions of its scenery. Dinant is very ancient, and it was considered a strong fortress as early as the twelfth century. In 1467 it was pillaged and dismantled by Philippe le Bon.

DINAPUR', a town of British India, the civil and military headquarters of the Patna district, in the province of Bengal, and on the right bank of the Ganges. The mutiny of 1857, in the Patna district, originated at Dinapur. There are barracks large enough to accommodate 1200 soldiers, and both a European and a native regiment are usually stationed here. The population is about 15,000.

DINAR'CHUS, one of the ten famous Greek orators. Dinarchus was a Corinthian by birth, and therefore could not legally speak in public, but he composed orations which Athenians delivered for him. He was born about B.C. 361. The time of his highest reputation was after the death of Alexander, when Demosthenes and other great orators were dead or banished. He also suffered exile, but was permitted to return to Athens for the last twenty years of his life. He died about B.C. 270. The three extant orations of Dinarchus are printed in the usual collection of the Attic orators. They all relate to HARPALUS, the fraudulent treasurer of Alexander the Great.

DINAR'IC ALPS extend S.E. from Mount Klek, in the Kapella range terminating the Julian Alps, divide Dalmatia from Croatia, and the streams seeking the Adriatic from those which flow to the Save. They have their name from Mount Dinara, and uniting with ridges and plateaus in Bosnia and Herzegovina, are connected through them with the Grammos or Pindus range of North Greece, and with the Western Balkan towards Prisrend.

DIN'GLE, a seaport and market-town of Ireland, in the county of Kerry, on the north shore of Dingle Bay, at the bottom of a capacious and well-sheltered harbour. The town is situated on the slopes of the mountains, which rise directly from the shore. It is frequented by persons labouring under pulmonary complaints, on account of the great mildness and equability of the climate, the mean temperature being 8½° Fahr. above Montpellier and 7° above Torquay. It is the most westerly town in the British Islands, and was formerly much frequented by Spaniards, who came to trade and fish. Its population is about 2,000. At the entrance to Dingle Bay is Valentia Island, the British terminus of the four telegraphic cables which cross the Atlantic, the other terminus being at Trinity Bay, in Newfoundland.

DIN'GO is a wild dog of Australia, being the only mammal found in that country not belonging to the Marsupialia. It is, however, probably not indigenous, though its introduction by man must have taken place at an early period. It is very wolf-like in appearance, and stands about 2 feet high, its body being 2½ feet in length. The head is elongated, the ears short and erect. The general colour is pale brown, growing lighter towards the belly. The dingo is very wild and savage, and at one time committed extensive ravages upon the colonists' flocks. Its depredations have, however, led to its partial extermination. It is capable of a degree of domestication. In a wild state it never barks.

DING'WALL, a royal burgh of Scotland, the county town of Ross-shire, contributory to the Wick district of burghs, on the Highland and Sutherland Railway, 615 miles from London, at the south-west extremity of Cromarty Frith, about 17 miles S.W. from Cromarty. It consists of one main street and one or two smaller ones branching from it. The streets are paved, and there are some good houses and shops. The parish church is a neat and commodious building, just out of the town. The town-house, a curious old building with spire and clock, is near the centre, and there is an Episcopal chapel. Of late years the town has been improved, and a public park was presented to it in 1874. The trade is also increasing. A short canal from the frith enables vessels with coal and other merchandise to come quite up to the town. The exports consist exclusively of wheat and other country produce, and its imports of lime and coals. On the east of the town are the ruins of the Castle of Dingwall. The population of the burgh numbers 1921. Dingwall is a Norse town, and means the Court Hill; in Gaelic it is *Inbhir-pheoran.* There is an obelisk 57 feet high, erected over the grave of one of the earls of Cromarty, which he ordered to be put up that his wife might not be able to carry out her threat of dancing over his tomb.

DINOSAU'RIA is an extinct order of REPTILES, of great importance as bridging over the gulf dividing that class from BIRDS. This group is entirely confined, as far as our present evidence goes, to the Mesozoic or Secondary age, reaching its highest development in the Jurassic epoch, and being extinct in the Cretaceous. From their abundance in the Triassic Professor Marsh thinks it probable that some, whose remains may yet be found, existed in the Permian period. Those from the Trias are known chiefly from footprints and fragmentary remains. Of some of the Jurassic Dinosaurs, however, skeletons have been almost entirely reconstructed, and through the labours of Owen, Huxley, and Marsh, not only their structure, but even their habits, have been determined with more or less certainty. Marsh raises the group to the dignity of a subclass, dividing it into four well-marked orders. The diversity of structure and variation in size exhibited by the different genera is very marked. They all agree, however, in having two pairs of limbs, the hind pair greatly developed and alone used for walking; the fore pair usually small, and possibly in some cases powerful weapons of offence. In some genera, as Iguanodon, the hind feet had only three toes. The enormous tridactyl footprints found in the red sandstone of the Trias in some parts of North America, though partly due to extinct birds, may be also traced to these reptiles. Remarkable approximations to the structure obtaining in birds are shown in the pelvis and hind limb. The body was in some cases covered with a naked skin, in others with an armour of bony plates. The vertebræ were mostly flat on their articular surfaces, a few of the anterior being concave behind (*opisthocœlous*). Teeth are confined to the jaws, and are lodged in distinct sockets. One of the most interesting of the group is the IGUANODON, remains of which were found in wonderful abundance in 1878 at Bernissart, in Belgium. It stood over 14 feet high, and, except for its long crocodile-like tail, had somewhat the shape of a duck. In interest it is rivalled by Compsognathus, the smallest of the Dinosaurs, probably not more than 2 feet in length. Huxley concludes that it "hopped or walked in an erect or semi-erect position, after the manner of a bird, to which its long neck, slight head, and small anterior limbs must have given it an extraordinary resemblance." It was found in the lithographic slates of Solenhofen in Bavaria in company with ARCHÆOPTERYX, a bird to which it shows many striking points of resemblance. Cetiosaurus was a gigantic vegetable-eating animal, probably with amphibious habits. Its length is estimated at between 60 and 70 feet, and its height at about 10 feet. MEGALOSAURUS, of nearly equal proportions, was highly carnivorous.

DINOTHE'RIUM is an extinct animal now placed with the elephant and mastodon in the order PROBOSCIDEA. Its fossil remains have been found in the Miocene formations of Germany, France, Greece, and Northern India. Till recently these consisted only of skulls and various bones of the head.

The largest species of this genus, *Dinotherium giganteum*, is calculated to have attained the extraordinary length of 18 feet. A skull disinterred at Eppelsheim, in Hesse-Darmstadt, measured 4 feet long by 3 broad.

Both jaws are provided with five molar teeth on each side; the third molar has three transverse ridges across its surface; the first has only one, the others two. The lower jaw is most remarkable; its anterior portion is greatly produced and reflected downwards, forming the sockets of two enormous tusks, which curve slightly backwards. The lower jaw, exclusive of these tusk-like incisors, measures nearly 4 feet in length. The upper jaw is destitute of either canines or incisors. From the situation and characters of the nasal orifice, with the salient bearing of the nasal bones, there is reason to suppose that the animal was furnished with a proboscis.

The position of Dinotherium was long doubtful. It has been variously classed with the dugongs, pangolins, tapirs, and seals. Its affinities with the elephant, however, have been proved by recent discoveries of limb-bones. It was probably aquatic or semi-aquatic in its habits, using its tusks either for digging up roots or as anchors by which to moor itself to the bank, or as climbing instruments to assist it in its efforts to ascend any steep place bordering the water's edge.

DI'OCESE. See BISHOPRIC.

DIOCLE'TIAN, CAIUS VALERIUS, Emperor of Rome, was born at Salona, in Dalmatia, about 245 A.D., but some make him ten years older. His original name was Diocles, which he changed into Diocletianus. His parentage was most obscure. He entered the army at an early age, and rose gradually to rank; he served in Gaul, in Mœsia under Probus, and was present at the campaign against the Persians in which the Emperor Carus perished. Diocletian commanded the household or imperial body-guards when young Numerianus, the son and successor of Carus, was secretly put to death by Aper his father-in-law on

the homeward march. The death of Numerianus being discovered after several days by the soldiers near Chalcedon, they arrested Aper and proclaimed Diocletian emperor, who protested his innocence of the death of Numerianus, and, upbraiding Aper for the crime, plunged his sword into his body. Diocletian in September, 284, entered Nicomedia, which town he afterwards chose for his favourite residence. Carinus, the other son of Carus, who had remained in Italy, having collected a force to attack Diocletian, the two armies met at Margum in Mœsia, where the soldiers of Carinus had the advantage at first, but Carinus was killed during the battle by his own officers, whom he had grievously injured by his cruel profligacy, and upon this both armies joined in acknowledging Diocletian emperor, A.D. 285. Diocletian used his victory with generosity.

The empire was at this time assailed in various quarters —on the Persian frontier, on the side of Germany and of Illyricum, and in Britain; a serious revolt, too, had broken out in Gaul. To quell the disturbance in Gaul, Diocletian sent thither his old friend Maximian, a brave but rude soldier, who defeated the insurgents. In the year 286 Diocletian chose Maximian as his colleague in the empire, under the name of Marcus Valerius Maximianus Augustus. Maximian was stationed in Gaul and on the German frontier; Diocletian resided chiefly in the East to watch the Persians. About A.D. 288 Maximian defeated the Germans near Treves, and Diocletian marched against other tribes on the Rhætian frontier. In 289 peace was made between CARAUSIUS, who had revolted in Britain, and the two emperors, Carausius being allowed to retain Britain and to assume the title of emperor. In 290 Maximian and Diocletian met at Milan to confer on the state of the empire, after which Diocletian returned to Nicomedia. The Persians soon afterwards again invaded Mesopotamia and threatened Syria, and, the empire being attacked on other sides also, Diocletian felt it imperatively necessary to increase the number of his colleagues. On 1st March, 292, he appointed Galerius as Cæsar, presented him as such to the troops at Nicomedia, and gave him his daughter as wife. At the same time Maximian adopted Constantius Chlorus, who also became his son-in-law. Diocletian kept Asia and Egypt; Maximian had Italy and Africa; Galerius, Thrace and Illyricum; and Constantius had Gaul and Spain. But it was rather an administrative than a political division. Writers have been very free of their censure upon Diocletian for parcelling out the empire, but it was the only chance of preventing its crumbling to pieces. The empire was much too large for one single man or a single central administration. Constantius defeated the Franks and the Alemanni, and soon after reconquered Britain. Each of the other rulers had also his successful wars to wage, but all four were finally victorious about 297, and for several years after this the empire enjoyed peace. Diocletian kept a splendid court at Nicomedia, which town he greatly embellished. Maximian caused the magnificent Baths of Diocletian at Rome to be built, the remains of which still exist near the railway station in modern Rome, and which contained, besides the baths, a library, a museum, and public walks.

In February, 303, Diocletian issued an edict against the Christians, ordering their churches to be pulled down, their sacred books to be burnt, and all Christians to be dismissed from offices civil or military, with other penalties, exclusive, however, of death. Various causes have been assigned for this measure. Galerius had always been hostile to the Christians, while Diocletian had openly favoured them. But the Christians were charged with conspiracies, and Diocletian was also superstitious; fear and superstition probably both combined to urge him to persecution. The church of Nicomedia was the first pulled down by order of the emperor. The rashness of a Christian, who publicly tore down the imperial edict, exasperated Diocletian still more; the culprit was put to a cruel death. A second edict ordered all magistrates to arrest the Christian bishops and presbyters, and compel them to sacrifice to the gods. This was the beginning of a cruel persecution, the last persecution under the Roman Empire, and it has been called by the name of Diocletian. But he had little share in it, beyond issuing the two edicts, which he did reluctantly and after long hesitation, according to the admission of Lactantius. Galerius, who had instigated the persecution, was the most zealous minister of it; and he continued it for several years after Diocletian's abdication. The countries under the government of Constantius suffered the least from it. Without in any way palliating the horrors of persecution, it must be remembered, as Merivale the historian was perhaps the first to point out, that to these pagan emperors the Christians, with their exclusive ceremonies, and their whole system cutting at the root of the ancient Roman civilization, seemed, as the ancients called them, a "detestable sect;" and further, the better the emperor the more truly he sought to restore the glory of Rome and revive the ancient republican virtues, therefore the more severe was he against the obstinate passive resistance offered by the Christians.

In November of the year 303 Diocletian repaired to Rome, where he and Maximian enjoyed a triumph, the last that Rome saw, and on the 1st of May, 305, Diocletian, who had returned to Asia, repaired with his guards to a spot 3 miles out of Nicomedia, where, addressing his officers and court, he said that the infirmities of old age warned him to retire from power, and he proclaimed Galerius as Augustus, and Maximin as the new Cæsar. (The Cæsar held a position roughly analogous to our "Prince of Wales.") Diocletian clothed Maximin with the purple vest, after which he set off for Salona in Dalmatia, near which he built himself an extensive and magnificent palace by the sea-shore, where he lived for the rest of his life. Part of the external walls which inclosed the area belonging to his palace and other buildings still remain, with three of the gates, as well as a temple, which is now a church at Spalatro or Spalato, in Dalmatia, a comparatively modern town, grown out of the decay of the ancient Salona, and built in great part within the walls of Diocletian's residence, from the name of which ("Palatium") it is supposed that Spalato is derived. The reader is referred to the article BYZANTINE ARCHITECTURE, and to the Plate to which that article refers (Plate BASILICA and BYZANTINE ARCHITECTURE), for an account of the architectural features of this palace. At the same time that Diocletian abdicated at Nicomedia, Maximian, according to an agreement between them, performed a similar ceremony at Milan, proclaiming Constantius as Augustus and Severus as Cæsar. In his retirement Diocletian cultivated his garden, and enjoyed that repose which power does not give. Once only he left his retirement to meet Galerius in Pannonia for the purpose of appointing a new Cæsar, Licinius, in the room of Severus, who had died. Licinius was not grateful, for after the death of Galerius, A.D. 311, he ill-treated his widow, Valeria, Diocletian's daughter, who with her mother, Prisca, took refuge in the territories of Maximin. Maximin offered to marry Valeria, but on her refusal exiled both her and her mother to the deserts of Syria. Diocletian remonstrated in favour of his wife and daughter, but to no purpose, and his grief on this occasion probably hastened his death, which took place at Salona, in July, 313. In the following year his wife and daughter were put to death by order of Licinius.

Diocletian was among the most distinguished emperors of Rome; his reign of twenty-one years was upon the whole prosperous for the empire. He must have been a man of consummate genius who could have brought the whole civilized world into settled order and peace after a century of fearful anarchy. He was severe, but not wantonly cruel.

His conduct after his abdication shows that his was no common mind. The Christian writers, and especially Lactantius, have spoken unfavourably of him. His laws or edicts are in the Codes of Theodosius and Justinian.

DIODO'RUS SIC'ULUS, a Greek historian, born at Agyrium in Sicily. The principal data for the chronology of his life are derived from his own work. He was in Egypt about 60 B.C. His History was written after the death of Julius Cæsar. It began before the Trojan War, and ended with Cæsar's campaign in Gaul; and he spent thirty years in writing it. The title of the great work of Diodorus is the "Historical Library," and it would therefore seem to have been intended by the author as a compilation from all the existing historical works. It was divided into forty books, and comprehended a period of 1138 years, besides the time preceding the Trojan War. Diodorus asserts that he travelled over a considerable part of Europe and Asia in order to prosecute his investigations. He resided some time at Rome, and made himself familiar with the Roman historians. Of the forty books of Diodorus' History we possess only fifteen—books i.–v. and books xi.–xx.—but we have many fragments of the twenty-five others, to which important additions have recently been made from MSS. in the Vatican library.

The principal fault of Diodorus seems to have been the too great extent of his work. It was not possible for any man living in the time of Augustus to write an unexceptionable universal history, nor is it possible now. It is not, then, a matter of surprise that Diodorus, who does not appear to have been a man of superior abilities, should have made many mistakes, and should have often placed too much reliance on indifferent authorities. Authentic history and conjecture, fact and legend, are told with the same interest and good faith. But the work is yet one of the most valuable which we possess. The form Diodorus adopts is that of annals. The events of each year are narrated as they occur, and but little attempt at philosophical arrangement or even grouping is made. Although he professes to have paid great attention to chronology his dates are frequently incorrect.

The best editions of Diodorus are Wesseling's (Amsterdam, 1745) and Dindorf's (Leipzig, 1829–33, five vols. 8vo), the latter containing the Vatican Excerpta.

DIŒ'CIOUS. See DICLINOUS.

DIOG'ENES is the name of three celebrated Greeks.

DIOGENES OF APOLLONIA, so called from his birthplace, a town in Crete, was a pupil of Anaximenes and a contemporary of Anaxagoras. He was born about 500 B.C. These early philosophers searched after the one element from which they thought the universe arose. Thales thought it was perhaps moisture or water. Diogenes followed Anaximenes in making air the primal element of all things, that out of which the whole material universe was formed; but he invested this air with the property of intelligence. Thus he faintly indicated the line so soon to be taken by the Greek philosophy—the study of mind as the creative and formative spirit, moulding matter into various forms.

He wrote several books on cosmology, and the first sentence of his work is given by Diogenes Laertius in two places. What remains of Diogenes of Apollonia is to be found among the "Philosophorum Fragmenta" (Paris, 1867).

DIOGENES, the Cynic philosopher, was a native of Sinope. His father Hicesius and himself were expelled from their native place on a charge of adulterating the coinage. Diogenes escaped to Athens. On his arrival there he betook himself to Antisthenes the Cynic, who repulsed him rudely, according to his custom, and even on one occasion threatened to strike him. "Strike me," said the Sinopian, "for you will never get so hard a stick as to keep me from you while you speak what I think worth hearing." The philosopher was so pleased with this reply that he admitted him among his scholars. Diogenes had been rich and luxurious, he was now poor and miserable: he had been flattered and honoured, he was now despised and a felon; he revenged himself by hating society, and living like a dog. Diogenes was soon distinguished for his neglect of personal conveniences, and by his sarcastic expressions. He dressed in a coarse double robe, which served him as a cloak by day and a coverlet by night, and carried a wallet to receive alms of food. A great number of his witty and biting apophthegms are detailed by his biographer Diogenes Laertius (vi. c. 2). He became famous, and even received a visit from Alexander the Great, who bade him ask for whatever he wanted. "That you will get out of the sun," replied the Cynic, on whom Alexander's shadow fell at the moment.

His theory of life was a mad and absurd stoicism; he went beyond any ascetic practices before or since in his scorn of pleasure, comfort, or decency. The body was to be despised, life was to be reduced to a bare subsistence. The protest against the gay luxurious existence of the Athenians was perhaps needed as a reaction, and however bitterly we may reproach the Cynic for his sarcasm against the divine creations of beauty we must accord an astonished praise to his endurance. He had no home, he slept in a tub, or often in the streets. He threw away the only article of furniture he possessed, his cup, so soon as he saw a boy drink out of the hollow of his hand. He tried to do without cookery, and lived on roots and raw meat, but even he could not tame his body to such brutal nourishment. Still he lived on what would have brought starvation to almost any other man. Had he stayed here we could have found a useful lesson in his conduct. But all his long life was spent in insulting his fellow-citizens. Nothing can excuse his habitual gross indecency, his reason for which was that all natural actions (after the manner of the animals) may with decency be performed in public. Nor his derision of noble feeling, as when he saw the Athenians busy preparing for a warlike expedition, and rattled his tub to and fro in the street, "because," said he, "I suppose I must make a noise and look busy, and this is about as noisy and useless as the rest of the work." At another time he cried out for a long time, "Approach, all men!" as if about to deliver a discourse; then, rushing upon the crowd from out his tub, he drove them away with blows of his stick, crying, "Away with you! I called for *men;* ye are excrements." Plato pierced the disguise of Diogenes, as Socrates had that of his master Antisthenes, and much after the same fashion. Diogenes forced his way into Plato's house when the philosopher was entertaining some friends in the best manner he could afford, and trampling on and defiling the carpets, &c., he cried, "Thus do I trample on the pride of Plato!" The "broad-browed one" calmly crushed him with the rejoinder, "Truly, and with greater pride than Plato's, O Diogenes!" for after all the moving spirit of Diogenes was a misanthropic selfishness, thinly veiled by humour.

Being taken by a piratical captain while sailing from Athens to Ægina, Diogenes was carried to Crete, and there sold to Xeniades, of Corinth, who took him to educate his children. He discharged his duties faithfully and successfully; and he was so well treated by his master that he refused an offer on the part of his friends to ransom him. He died at Corinth in the same year as Alexander the Great (323 B.C.), at the age of ninety years. His followers found him lying dead in the public street, under a portico, wrapped in his cloak. The following are a few of the opinions which are ascribed to him by his biographer:—He thought exercise was indispensable, and able to effect anything; that there were two kinds of exercise, one of the mind and the other of the body, and that one of these was of no value without the other. By the cultivation of the mind he did not mean the prosecution of any science or the acquirement of any mental

accomplishment; all such things he considered as useless; but he intended such a cultivation of the mind as might serve to bring it into a healthy and virtuous state, and produce upon it an effect analogous to that which exercise produces upon the body. He was of opinion that there should be a community of wives and children.

DIOGENES, surnamed *Laertius*, because he was born at Laertius, in Cilicia, was the biographer of the Greek philosophers. It is supposed that he lived in the reign of Severus or Caracalla, and that he was an Epicurean. The work by which Diogenes is known is a crude contribution towards the history of philosophy. It contains a brief account of the lives, doctrines, and sayings of most persons who had been called philosophers; and though the author is evidently a most unfit person for the task which he imposed upon himself, and has shown very little judgment and discrimination in the execution, the book is useful as a collection of facts. The article on Epicurus is valuable as containing some original letters of that philosopher, which comprise a pretty satisfactory epitome of the Epicurean doctrines, and are very useful to readers of Lucretius. The most convenient edition of Diogenes is that by H. G. Hübner (Leipzig, 1828–31, in two vols. 8vo).

DI'OMED (*Diomedes*) was one of the chief heroes of the Trojan War. He was king of Argos, and was the son of Tydeus: he is very commonly therefore called Tydides in the Iliad. When still a youth he was one of the second (and victorious) "Seven against Thebes." [See EPIGONI.] Diomed enjoyed the special protection and favour of Athena, and so distinguished himself both by bravery and address in the famous siege of Troy that he must fairly be ranked next to Achilles. He alone could cope as equal with the great Hector, and in the course of the war he wounded both Ares, god of battle, and Aphrodite, goddess of love, in each case being assisted by Athena. He it was who with Ulysses (Odysseus) stole the PALLADIUM from Troy, and thus neutralized the oracle which had declared the city impregnable while the palladium was secure within its walls. Troy having fallen Diomed, bearing with him the palladium (which he afterwards lost), returned to Argos. Here disaster awaited him. The angry Aphrodite after her wound had inflamed the queen of Diomed with a wicked passion for another man, and the unfaithful wife with her paramour drove the hero back to the sea when with his followers, fatigued with many trials, he attempted to land. He was thrown upon the shores of Apulia in a violent storm, and was most generously received by Daunus, king of that region. He remained in Italy till his death, married the king's daughter, led his armies to successful wars, and made himself universally honoured and beloved. The islands off the promontory of Garganum in Apulia bore his name in his honour (the Diomedes), and one of them received his remains. Many of the towns in "Magna Græcia" (South Italy) were said to have been founded by the great Diomed, and he was worshipped as their patron divinity, much as Romulus was worshipped by the Romans.

DIOME'DES, THE HORSES OF, are the subject of one of the many picturesque myths surrounding the figure of Herakles (Hercules). Diomedes was a king of the Bistones in Thrace, and had a breed of fierce horses which he fed on human flesh. The horses had plenty of their horrible food, for wrecks were incessant on the inhospitable coast. They were given to the king by his father Ares, god of battle. One of the labours of Herakles was to bring these horses to Mycenæ at the command of his tyrant, Eurystheus. He soon dispersed the guards of the horses by his prodigious strength, and burst the stout chains which alone restrained them from devouring the Thracians; but as he led the horses to the ships Diomedes with his subjects fell upon him. In the furious contest which ensued the king was slain by Herakles, and the horses at once devoured him. The demigod succeeded in his mighty task, but no one could restrain the creatures when he let them loose in Mycenæ. They rushed off into the woods, and Zeus quickly sent wolves to rid the country of such dangerous monsters.

DI'ON or **DIO'ON.** See CYCADACEÆ.

DI'ON OF SYRACUSE, son of Hipparinus, one of the chief men in that city, lived under the reigns of both the Dionysii. His sister became the second wife of the elder Dionysius, tyrant of Syracuse, who was also a relative by blood of Dion's. Dion was the trusted friend and adviser of Dionysius, and next to the tyrant himself was the wealthiest and most powerful man in the state. He was also remarkable for literary and philosophical talent. He had early become the disciple of Plato, whom the elder Dionysius had invited to Syracuse. Dion married the daughter of Dionysius. He offered, however, no opposition to the accession of the younger Dionysius, although the depraved character of the young man was very displeasing to the lofty and austere disciple and friend of Plato. Soon after his accession the younger Dionysius began to show the effects of a vicious education, and he abandoned himself to all kinds of excess. The prospects of his country roused Dion, and he endeavoured to counteract the errors of the tyrant by prudent counsels and exhortations. Among other things he persuaded Plato to revisit the Syracusan court, and Dionysius wrote a letter of invitation. The presence of Plato was dreaded by the dissolute courtiers who surrounded Dionysius, and to counteract his influence they insinuated suspicions of Dion's loyalty, and succeeded in procuring his banishment. He went first to Italy, and then to Greece, where he received the highest honours. Dionysius confiscated his lands and effects, and forced his wife to marry another. Dion no sooner heard of this outrage than he determined to make an effort to expel the tyrant. He began to raise troops privately, and at last assembled his forces, to the number of 800, in the island of Lante, whence he sailed to Sicily. On landing Dionysius fled to Italy, and Dion was received by the people with great joy, and remained undisputed master of the city, being able to prevent the attempted return of Dionysius B.C. 356. Dion's rigid principles were, however, too great a reaction for the Sicilians to bear, and he did not long enjoy the favour of his countrymen. He was obliged to leave Sicily, but was afterwards recalled, and treacherously murdered, B.C. 353, when about fifty-five years of age, by his supposed friend Calippus, an Athenian. His death was generally regretted, and a monument was raised to him at the public expense.

DI'ON, surnamed *Chrysostomus*, or the Golden-mouthed, was a sophist and stoic, and a contemporary of the emperors Vespasian, Domitian, Nerva, and Trajan. He resided for some years at Rome, till one of his friends, having engaged in a conspiracy against Domitian, was condemned to death, and Dion, fearing for himself, fled to the country now called Moldavia, where he remained till the tyrant's death, labouring for his subsistence with his own hands, and possessing no books but the "Phædo" of Plato and an oration of Demosthenes against Æschines. He then assisted in the recognition of his friend Nerva as emperor, and returned to Rome, where he died at an advanced age about 117 A.D. He took the surname of Cocceianus on account of his friendship with Nerva, one of whose names was Cocceius. Trajan also held Dion Chrysostom in great regard. We have eighty orations attributed to him, which are written in a very refined and elegant style in Attic Greek, but not of much intrinsic value. The best edition is that of Reiske (two vols. 8vo, Leipzig, 1784).

DI'ON CAS'SIUS, surnamed *Cocceius*, was the son of Cassius Apronianus, a Roman senator, and born at Nicæa in Bithynia about A.D. 155. On his mother's side he was descended from Dion Chrysostom, and it was from this branch of his family that he took the names of Dion and

Cocceius. Under Commodus he lived in Rome, where he enjoyed the rank of senator. After the death of Caracalla he was made governor of Smyrna and Pergamus by Macrinus. He was afterwards consul and proconsul in the several provinces of Africa and Pannonia, probably under Alexander Severus, who esteemed him so highly as to make him consul for the second time with himself. In his old age he returned to his native country.

Dion wrote a history of Rome in Greek, from the arrival of Æneas in Italy and the foundation of Alba and Rome to A.D. 229. To the time of Julius Cæsar his history was only a rapid sketch, but from that date his narrative is very complete. Of the first thirty-six books there are only fragments extant; but there is a considerable fragment of the thirty-fifth book on the war of Lucullus against Mithridates, and of the thirty-sixth on the war with the pirates and the expedition of Pompey against Mithridates. The following books to the fifty-fourth inclusive are nearly all entire; they comprehend a period from B.C. 65 to B.C. 10, or from the eastern campaign of Pompey and the death of Mithridates to the death of Agrippa. The fifty-fifth book has a considerable gap in it. The fifty-sixth to the sixtieth, both included, comprehend the period from A.D. 9 to 54, and the events from the defeat of Varus in Germany to the reign of Claudius. Of the following twenty books we have only fragments, and the meagre abridgment of Xiphilinus. The eightieth or last book comprehends the period from A.D. 222 to 229, in the reign of Alexander Severus.

The annals of Zonaras contain numerous extracts from Dion, and the fragments have been carefully collected. The history is very valuable as a collection of facts, but it is disfigured by the author's credulity wherever he has anything bad to say of anyone. He was well acquainted with Roman institutions—superior in this respect to Dionysius of Halicarnassus. He is of inestimable merit when he relates events of which he was an eye-witness.

The edition of Dion Cassius by Reimarus (Hamburg, 1751–52, two vols. folio) contains a Latin translation and valuable notes. The latest edition is by F. W. Sturz (Leipzig, 1824, 1843, eight vols. 8vo).

DIONÆ'A, a most singular herbaceous plant, remarkable for the irritability of its leaves, which, when brushed against by an insect, will suddenly close upon it and hold it fast, whence it is often called Venus' Fly-trap and the Carolina Catch-fly Plant. It is botanically related to the Drosera, or Sundew, which has also the property of seizing insects by its viscid hairs. The *Dionæa muscipula* is found as far north as Newbern, North Carolina, and from the mouth of Cape Fear River to Fayetteville. It is found in great plenty for many miles around Wilmington in every direction. The leaf, which is the only remarkable part, springs from the root, spreading upon the ground at a little elevation above it. Each portion of the leaf is a little concave on the inner side, where are placed three delicate hair-like organs, in such an order that an insect can hardly traverse it without interfering with one of them, when the two sides suddenly collapse and inclose their prey, with a force surpassing an insect's attempts to escape. The insects are digested and the juice absorbed. In 1874 Dr. Hooker made a communication to the British Association on the subject, since which Darwin more fully investigated it, and it is found that several other varieties of plants possess the same properties. (See Darwin's "Insectivorous Plants.") See DARLINGTONIA, DROSERA, SARRACENIA, NEPENTHACEÆ, INSECTIVOROUS PLANTS.

DIONYS'IUS was the name of the two celebrated "tyrants" or despotic rulers of Syracuse.

DIONYSIUS THE ELDER was born at Syracuse about 430 B.C. In the civil troubles of Syracuse, between the party of Diocles and that of Hermocrates, who was accused of aspiring to the supreme power, Dionysius took part with Hermocrates, and was wounded in an attempt which Hermocrates made to take possession of Syracuse. He afterwards married the daughter of Hermocrates, a great honour for one who had risen from the ranks of the people. Meantime the Carthaginians had effected their second invasion of Sicily, and had taken Selinus, Himera, and Agrigentum. Dionysius, who was now about twenty-five, used every artifice of intrigue to get the command of the war into his hands, and was at last proclaimed general of the republic about 405. He increased the pay of the soldiers, enlisted new ones, and under pretence of a conspiracy against his person formed a guard of mercenaries. He then proceeded to the relief of Gela, but failed in his attack on the Carthaginian camp; he however penetrated into the town, the inhabitants of which he advised to leave it in the night under the escort of his troops. On his retreat he persuaded those of Camarina to do the same. This bred suspicion among his troops, and a party of horsemen, riding on before the rest, raised an insurrection at Syracuse against Dionysius, plundered his house, and treated his wife so cruelly that she died. Dionysius followed close after, forced his way into the city, put to death the leaders of the revolt, and remained in possession of the supreme power. The Carthaginians, being afflicted by a pestilence, made proposals of peace, which were accepted by Dionysius, on condition, among other stipulations, that they should retain, besides their old colonies, the territories of Agrigentum, Selinus, and Himera. Himilco with the Carthaginian army then returned to Africa, and Dionysius applied himself to fortify Syracuse, and especially the island Ortygia, which he peopled with his trusty partisans and mercenaries. He took the towns of Leontini, Catana, and Naxus, and subjected them to Syracuse, and he prepared for war against Carthage by collecting men, manufacturing arms, and inventing new engines for besieging towns. In the year 397 he proposed the war, which was unanimously voted by the people. Dionysius reduced several towns belonging to the Carthaginians. A large force under Himilco landed at Panormos, but its advance was stopped by a great eruption of lava from Ætna, and Himilco was obliged to march round by the western base of the mountain. Meantime Mago with the Carthaginian fleet defeated the Syracusan fleet off Catana. Himilco encamped under the walls of Syracuse, while his victorious fleet entered the great harbour. But a dreadful pestilence breaking out in Himilco's camp, Dionysius, who had received aid from Sparta, attacked the Carthaginians and burned most of their ships. Himilco with the remainder escaped to Carthage, having paid secretly a large sum to Dionysius for his forbearance.

Dionysius seems now to have aspired to the dominion of Italy and Sicily. In 387 he crossed the sea and took Rhegium, in Magna Græcia (South Italy), and other cities as well. In order to raise money he plundered several temples, such as that of Persephone, at Locri. He was checked in his career by a fresh Carthaginian armament, which landed in Sicily in 383, and defeated Dionysius, whose brother Leptines fell in the battle. A peace followed, of which Carthage dictated the conditions, and the boundary of the two states was fixed at the river Halycus. This peace lasted fourteen years, during which Dionysius remained undisturbed ruler of Syracuse and one-half of Sicily, with part of Southern Italy. He sent colonies to the coasts of the Adriatic. Twice he sent assistance to his old ally, Sparta—once against the Athenians in 374, and again in 369, after the battle of Leuctra, when the Spartans were hard pressed by Epaminondas. Meantime the court of Dionysius was frequented by many distinguished men. Plato was invited by Dion, the brother-in-law of Dionysius, but the philosopher's declamations against tyranny led to his being sent away from Syracuse. The poets fared little better, as Dionysius himself aspired to poetical glory.

Those who did not praise his verses were in danger of being sent to prison. Dionysius twice sent some of his poems to be recited at the Olympic games, but they were hissed by the assembly. He was more successful at Athens, where a tragedy of his obtained the prize. He had just concluded a fresh truce with the Carthaginians, and he now gave himself up to rejoicings for his poetical triumph. In a debauch with his friends, in 367 B.C., he fell down senseless and soon after died—some say he was poisoned—in the sixty-third year of his age, having been tyrant of Syracuse thirty-eight years. After the death of his first wife he married two wives at once, one being Dion's sister; his elder son by the other wife succeeded him in the sovereignty.

Dionysius was a clever and successful statesman; he was unscrupulous, rapacious, and vindictive, but several of the stories of his cruelty and suspicious temper appear to be exaggerated. The works of Philistus, who had written his life, and who is praised by Cicero, are lost. Diodorus, who is our principal remaining authority concerning Dionysius, lived nearly three centuries after. The government of Dionysius, like that of many others who are styled tyrants in ancient history, was not a pure despotism; it resembled rather that of the first Medici and other leaders of the Italian republics in the middle ages, or that of the stadtholders in Holland.

Dionysius the Younger, son of Dionysius the Elder, succeeded him as tyrant of Syracuse. His father had left the state in a prosperous condition, but young Dionysius had neither his abilities nor his prudence and experience. He followed at first the advice of Dion, who invited his friend Plato to return to Syracuse about 364 B.C. But when Plato in vain urgently demanded of Dionysius the recall of Dion (who had been exiled—see Dion) he left Syracuse, after which Dionysius gave himself up to debauchery without restraint. Aristippus, who was then at his court, was the kind of philosopher best suited to the taste of Dionysius. When Dion returned to Syracuse with a small force and got possession of the city, Dionysius quitted it and retired to Locri, in Italy, the country of his mother, where he had connections and friends.

Several tyrants succeeded each other in Syracuse after Dion's murder (B.C. 353), until Dionysius himself retook it about 346. Dionysius, however, instead of improving by his ten years' exile had grown worse. His cruelty and profligacy drove away a great number of people to various parts of Italy and Greece, at whose prayer the Corinthians sent Timoleon to Sicily, 344 B.C., who quickly deposed the hated tyrant. Dionysius was sent to Corinth, where he spent the remainder of his life in the company of actors and low women; some say that at one time he kept a school.

DIONYS'IUS was also the name of several writers and philosophers among the Greeks.

Dionysius of Halicarnassus was born at that town about B.C. 55. He came to Italy in B.C. 29, and he spent the following two-and-twenty years at Rome in learning the Latin language, and in collecting materials for his history. The principal work of Dionysius is his "Roman Antiquities," which commenced with the early history of the people of Italy and terminated with the beginning of the first Punic War, B.C. 264, when Polybius begins. The extant portion, however, only extends to the period of the decemvirs. Though Dionysius has evidently written with much greater care than Livy, and has studied Cato and the old annalists more diligently than his Roman contemporary, yet he wrote with an object which invalidates his claim to be considered an impartial historian. Dionysius wrote for the Greeks; and his object was to relieve them from the mortification of being conquered by a race of barbarians, as they considered the Romans to be. This he endeavoured to effect by twisting and forging testimonies and botching up the old legends, so as to make out a proof of the Greek origin of the city of Rome, and he inserts a great number of set speeches, evidently composed for the same purpose. He indulges in a minuteness of detail which, though it might be some proof of veracity in a contemporary historian, is an indication of a want of faith in the case of an ancient history so obscure as that of Rome. With all his study and research, Dionysius was imperfectly acquainted with the Roman constitution. Dionysius also wrote a treatise on rhetoric, criticisms on the style of Thucydides, Lysias, Isocrates, Isæus, Dinarchus, Plato, and Demosthenes; a treatise on the arrangement of words, and some other short essays. His critical works are much more valuable than his history, and a few remarks on the pronunciation of Greek are of inestimable value, since, like Quintilian ("De Oratore") for Latin, they fix the sounds of the ancient language. The best edition of Dionysius is by Reiske (Leipzig, 1774–1777, six vols. 8vo). Mai discovered and published at Milan some important later fragments of the history in 1816.

Dionysius Areopagitica is so named because he was a member of the council of the Areopagus, and is believed to have been converted by St. Paul's preaching "on Mars' Hill" (Areopagus): "Howbeit, certain men clave unto him, and believed; among the which was Dionysius the Areopagite" (Acts xvii. 34). But the "Celestial Hierarchy," the "Name of God," and the "Mystical Theology," &c., bearing this author's name are so far spurious; for they are certainly as late as the fifth century.

These were translated into Latin by Erigena, the famous "schoolman" of mediæval times, and became at once the text-book of angelic lore in the middle ages. Milman (in his "History of Latin Christianity," viii. 189) effectually disposes of the question of date of authorship, but acknowledges their captivating nature for the monastic mind, which greedily swallowed writings so precious without much cavil as to their authenticity. They were sent as a treasure of life by the Emperor of Byzantium to the Frankish emperor Louis II. the Pious (great grandson of Karl the Great), and by his order translated by Erigena about 860. Dante places Dionysius the Areopagite in Paradise, with these lines, in his brief trenchant style—

> "Thou seest next the lustre of that light
> Which in the flesh, below, looked most within
> The angelic nature and its mystery."
> —"*Paradiso*" X.

St. Thomas Aquinas continually quotes the Areopagite in his "Summa Theologiæ." It is from the latter that all the "machinery" of the mediæval heaven comes, such as the three Hierarchies and their threefold subdivisions:—Seraphim, Cherubim, Thrones (the highest); Dominions, Virtues, Powers (the middle); Principalities, Archangels, Angels, &c. As sometimes this conception is still referred to, and as in fact it is impossible to take up Dante or any other book of the middle ages without running against it in some form or another, it will be worth while to add the various concentric crystal spheres of heaven in which the above ninefold hierarchy dwelt. It must be premised that these spheres were conceived to be those in which the orbs to be named were fixed, the moon being in the sphere nearest the earth, the fixed stars in that the furthest away, the *primum mobile* which surrounded this last having no "regent" or heavenly body ruling it, but being the source of the motion of the universe borne along directly by the divine mind. Taking these in the same order as before, the Seraphim inhabit the Primum Mobile, the Cherubim the sphere of the fixed stars, the Thrones that of Saturn. The Dominions inhabit the sphere of Jupiter, the Virtues that of Mars, the Powers that of the Sun. The Principalities inhabit the sphere of Venus, the Archangels that of Mercury, the Angels (who alone have direct communion with earth) the sphere of the Moon, in conformity with their duties.

Dionysius the Areopagite was confounded by the "Golden Legend" with Dionysius the patron saint of France (St. Denis), bishop of Paris in the third century, although we know (Acts xvii.) he lived in the time of the apostles. Tradition, preserved by the "Golden Legend," makes him the author of a letter to Polycarp, written at Heliopolis, describing the darkness which clouded the day during the crucifixion, "though this was not the time for an eclipse." Milman takes care to praise the imaginative richness, the occasional beauty, and the deep piety of the fifth century treatises bearing this venerable name.

DIONYS'IUS. The following are some of the other celebrated ancients bearing this name. *St. Dionysius of Alexandria* succeeded Heraclas as patriarch (A.D. 247–265). Some fragments of his works yet remain. *Dionysius Cato* wrote a short collection of moral distichs for youth, which were universal in schools down almost to the present century. Bailey's edition (London, 1771) is a good one. Cato wrote under the Antonines. *Dionysius Chalcus* was a poet and orator of Athens, and led the Athenian colony to Thurii, in Italy, B.C. 444. He advised the coining of money of brass (Gr. *chalkos*), whence his name. *Dionysius of Colophon* was a painter of sufficient note to be compared by Aristotle to his great contemporary Polygnotus. *Dionysius of Heraclea* was a Stoic, a pupil of the master Zeno himself. But as he abandoned Stoicism for the gentler Eleatic philosophy, he generally goes by the name of "the renegade." He starved himself to death voluntarily B.C. 260. *Dionysius of Miletus* is one of the earliest of the Greek historians. He wrote in Persia about B.C. 500. (Latest edition in the "Hist. Græc. Frag." of Didot, Paris, 1872.) *Dionysius Periegetes*, about B.C. 300, wrote in hexameters a description of the whole habitable world ("Periegesis"). It was very popular with the ancient Greeks and Romans, and was twice translated into Latin, but has no real value. The best edition of the original is by Bernhardt of Leipzig (1828). *Dionysius Thrax* ("the Thracian," from his birthplace) taught grammar at Rome about 80 B.C., and his little book on the subject was the standard work for centuries, and may indeed be regarded as the basis of all the older grammars.

DIONY'SUS (Gr. *dionusos*), god of wine and of the drama, was also called Bacchus and Iacchus, and many other names. The Romans adopted the first of these Greek secondary names, which in itself means simply noisy (*Βάκχος*, noisy) or riotous, as if through drinking wine, an appropriate epithet for the god of the BACCHANALIA. For an account of the "god of the many names," see BACCHUS. The same article includes an account of the Dionysia, vintage festivals in honour of Dionysus, which must not be confused with the orgies of the Bacchanalia.

DIOPHAN'TUS OF ALEXANDRIA, the author of the only Greek work which contains algebra. What we have of it is six books of algebraic investigation of the properties of integer numbers, with a book on polygonal numbers. It has been printed, once in Latin, and twice in Greek and Latin. (It must not be understood that it is a treatise on algebra, which is another thing. It uses algebraic methods, and stands alone in this.) Diophantus mentions, and therefore must have lived after, Hypsicles the mathematician, who is known to have lived not earlier than the end of the sixth century; we must therefore place Diophantus at the beginning of the seventh at the earliest.

DIOP'SIDE is a mineral considered by some authorities as simply a sub-species of augite (Dana's pyroxene), while others consider it a separate species. No line of demarcation can, as a matter of fact, be drawn between the augites and the diopsides, and it is doubtful whether the differences between typical diopside and typical augite ought to be considered of specific value. The name diopside is given to silicates of lime and magnesia, corresponding roughly to the formula $CaO,SiO_2 + MgO,SiO_2$, containing not more than from 3 to 4 per cent. of iron oxide and no alumina. They crystallize in the monoclinic system, and have a specific gravity of 3·2 to 3·3, varying in colour from dark green to very light yellowish-green, sometimes almost colourless. Under the head diopside are included the varieties *malacolite* (found in Sweden), *alalite*, *mussite*, and *traversellite* (found in Piedmont). The relations of diopside to the other members of the augite group are mentioned under AUGITE.

Large and well-crystallized specimens of diopside have been formed in furnaces. The mineral has also been formed artificially by the action of steam on glass under great pressure.

DIOP'TRICS. See REFRACTION.

DIORAM'A (from a Greek word signifying to see through), a mode of painting and scenic exhibition invented by two French artists, Daguerre and Bouton. The peculiar and almost magical effect of the diorama arises, in a considerable measure, from the contrivance employed in exhibiting the painting, which is viewed through a large aperture or proscenium. Beyond this opening the picture is placed at such a distance that the light is thrown upon it, at a proper angle, from the roof, which is glazed with ground glass, and cannot be seen by the spectator. The light may be diminished or increased at pleasure, and that either gradually or suddenly, so as to represent the change from ordinary daylight to sunshine, and from sunshine to cloudy weather or to the obscurity of twilight, also the difference of atmospheric tone attending them. Some parts of the painting are transparent, and on them the light can occasionally be admitted from behind, thereby producing a brilliancy far exceeding that of the highest lights of a picture upon an opaque ground. The combination of transparent, semi-transparent, and opaque colouring, still further assisted by the power of varying both the effects and the degree of light and shade, renders the diorama the most perfect scenic representation of nature.

DI'ORITE, a group of rocks roughly equivalent to the so-called "greenstone," using that term in its restricted and modern sense. The rocks of this group are essentially a mixture of a triclinic (that is, plagioclastic) felspar with hornblende. They are distinctly crystallized, plutonic rocks, belonging to the intermediate system of which, with syenite, they form the granite type. They average from 60 to 65 per cent. of silica, and have a specific gravity of from 2·75 to 2·85. In colour they vary somewhat considerably, but are usually gray. Diorite is often mistaken for gray granite, from which it may usually be distinguished, however, by the absence or rarity of quartz, which is very plentiful in a true granite. Diorites are divided into, (1) Oligoclase diorites, (2) Labradorite diorites, and (3) Quartz diorites.

(1) Oligoclase diorite is a diorite in which the bulk of the felspar is oligoclase. Orthoclase is sometimes present, but only in small quantities. The hornblende is sometimes in great part replaced by biotite (magnesium mica); when this is the case, the rock is usually known as a mica diorite. Augite is sometimes present, apatite frequently so. Chlorite, pyrites, magnetite, and ilmenite are often present; garnet, sphene, and epidote are occasionally met with.

(2) Labradorite diorite differs from oligoclase diorite only in having part or all of the oligoclase replaced by Labradorite. All that has been said about the latter class, except in this respect, applies to the former equally well.

(3) Quartz diorite is, as its name implies, a diorite containing quartz. *Tonalite*, a rock found at Tonale Pass, in Tyrol, till recently considered a granite, is a micaceous quartz diorite. *Norite*, a rock found at Hitteroe, on the Norwegian coast, is similar in constitution, but contains diallage, and thus connects the diorites with the gabbros.

Diorite frequently occurs as dykes, sometimes cutting through granite. It is by no means a common rock in Great Britain. The best localities for finding specimens are—St. Mewan's, Cornwall; Trewasus Head, Cornwall; Chilvern Coton, near Nuneaton; Lendal Foot, in Ayrshire; and one or two places in Guernsey.

DIOSCOREA'CEÆ is a natural order of MONOCOTYLEDONS. All the species are twining shrubs, with alternate or spuriously opposite leaves. They consist, with the exception of Tamus (or black bryony) of tropical plants, or at least of such as require a mild frostless climate. Some of them produce eatable farinaceous tubers; but there is a dangerous acrid principle prevalent among them, which renders the order upon the whole suspicious. The genus Dioscorea furnishes the tropical esculents called yams. There are several species of this genus. The common West Indian yam, which is often sold in the shops of London, is produced by *Dioscorea alata*. It is met with in the East Indies also, but only in a cultivated state. Its tubers are oblong, brown externally, white internally, and often of great size, weighing sometimes as much as 30 lbs.; they perish after the first year if left in the ground, having first produced the young ones that are to replace them. *Dioscorea globosa*, cultivated in Bengal, is the most esteemed of the Indian yams. Its flowers are highly fragrant; the tubers are white internally; the leaves arrow-headed. *Dioscorea rubella* is another Indian sort with large tubers stained with red immediately below the cuticle; it is much esteemed; its tubers are sometimes 3 feet long; its flowers are fragrant. Another valuable kind is *Dioscorea purpurea*, whose tubers are permanently stained purple throughout. At Malacca is cultivated another purple-rooted sort, the *Dioscorea atropurpurea*, whose tubers are large and irregular, and grow so near the surface of the ground as to appear in dry weather through the cracks that they make in the soil by raising the earth over them. Other eatable sorts are numerous, but are less valuable, and therefore not cultivated. *Dioscorea Batatas* has within recent years been introduced into this country from China and Japan, where it is used as an article of food; but it is very doubtful whether it will ever become with us a substitute for the potato; the roots penetrate deep into the ground. The "elephant's foot" of the Cape (*Testudinaria elephantipes*) belongs to this order; it has a very large, tuberous, warty stem at the base, looking somewhat like a short stump of a tree, from which springs a delicate climbing stem; the central part of the tuberous growth is eaten by the Hottentots.

It is not a little remarkable that while so many species are nutritious in this genus, some (*e.g.* TAMUS) should be dangerous; but such is unquestionably the fact. This order has been placed by Bentham and Hooker ("Genera Plantarum") in the series Epigynæ of the Monocotyledons. It is distinguished by the flower being regular, unisexual; the perianth small, corolla-like; stamens six, perfect, or those opposite the inner lobes imperfect or wanting; ovary inferior, three-celled, with two ovules; embryos small, in fleshy albumen.

DIOSCOR'IDES, PEDA'CIUS or **PEDA'NIUS**, a Greek writer on materia medica, was born at Anazarbus, in Cilicia, and flourished in the reign of Nero. He was a friend of the consul Licinius Bassus. In early life he seems to have been attached to the army; and either at that time or subsequently he travelled through Greece, Italy, Asia Minor, and some parts of Gaul, collecting plants with diligence, and acquainting himself with their properties, real or reputed. He also gathered together the opinions current in his day concerning the medical plants brought from countries not visited by himself, especially from India, which at that time furnished many drugs to the western markets. From such materials he compiled his celebrated work on "Materia Medica," in five books, wherein between 500 and 600 medicinal plants are named and briefly described.

Few books have ever enjoyed such long and universal celebrity as the "Materia Medica" of Dioscorides. For sixteen centuries and more, to use the words of one of his biographers, this work was referred to as the fountain-head of all authority by everybody who studied either botany or the mere virtues of plants.

The most celebrated MS. of Dioscorides is one of the sixth century, now at Vienna, illuminated with rude figures. Dioscorides will be found in the "Medicorum Græcorum Fragm.," Kühn (Leipzig, 1833), and in the "Hist. Græc. Fragm.," Didot (Paris, 1872).

DIOSCU'RI ("the sons of Zeus," *Dios* being the genitive of *Zeus*), the famous twins, Castor and Pollux, who shine in ancient myth and in the skies (as the constellation Gemini). See CASTOR.

DIP (of a magnetic needle), **DIPPING NEEDLE**, &c. See INCLINATION OF THE NEEDLE.

DIP is a term used in geology to denote the inclination of the plane of a stratum to the horizontal. The stratum is treated as a plane, though in reality part of a curved surface. The dip is expressed, just as the angle between any two planes would be, in degrees; thus a horizontal bed has a dip of 0°, a vertical one a dip of 90°. The dip is measured with a CLINOMETER. Some precautions are necessary in observing a dip. The clinometer must be parallel to the direction of dip; that is, it must be at right angles to the strike (or to the outcrop). Again, the observer should get as much of the section of the stratum in view as possible, for strata, especially if thin-bedded, are occasionally somewhat bent at their upper extremity. When the dip is outward in every direction from a central point, it is called *qua-qua-versal*. The dip of a vein or lode, called its *hade* in the north country, is reckoned in the same way. But a lode will vary much in dip at different parts of its course, being almost invariably affected by meeting a fresh rock. It is a curious fact that in most instances the greater the dip (*i.e.* the more nearly vertical) the richer the lode. The average dip of Cornish lodes is about 70°.

A clear cut cliff or steep hillside is best adapted for showing dip.

DIPHTHE'RIA is a specific contagious blood disease, occurring frequently in an epidemic form, and characterized by a peculiar inflammation of the mucous membrane of the throat and air passages; there is also generally some affection of the spleen and kidney, together with much general prostration. It has often been confounded with croup, malignant sore throat, and scarlet fever, and it is only within comparatively recent years that the specific character of the disease has been clearly recognized. The French called it diphtherite (from the Gr. *diphthera*, any leathery material), and in 1859 the name diphtheria was first applied to it in the registrar-general's returns, and soon became a well-known and established term.

The onset of an attack is marked by lassitude and prostration, headache, and a tendency to sickness and diarrhœa, aching in the back and legs, pallor of the skin, and pain in the throat. The pulse becomes rapid, the tongue coated, the appetite impaired, and there is more or less thirst. The urine is pale, and generally contains a little albumen. It becomes difficult and even painful to swallow, and this pain extends often to the ears, and there is a feeling of stiffness in the muscles of the neck. The most characteristic appearance in diphtheria is the formation of a false membrane over the upper and back part of the mouth and throat. It is soft, of an ashy-gray colour, and has been compared in appearance to that of a "damp, dirty-washed leather." When removed it leaves behind a red and raw surface, over which it rapidly re-forms again. This mem-

brane, too, may also appear on any abraded surface, mucous membrane, or on the skin; and if there be an open wound anywhere the surface will cease to heal, and become covered with the unhealthy fungus. It is apt during the progress of the disease to become detached, and as it loosens it undergoes a process of decomposition, giving an offensive and characteristic odour to the breath. In addition to the general symptoms enumerated, there are frequently eruptions upon the skin and an enlargement of the glands of the throat.

The disease is a very fatal one, and death often occurs in a very short time. Cases have been observed in which the patient died in less than twenty-four hours from the first shock of the poison of the disease, without any characteristic sign except prostration, and where it is more slow in its action the disease may run its course and produce fatal results in two or three days. Where it assumes an epidemic form, the percentage of fatal cases is sometimes very high; in the case of an epidemic of diphtheria which occurred in France in 1847 the mortality reached 91 per cent., and in that which occurred in Paris in 1876 the mortality in the hospitals of that city reached nearly 80 per cent.

There is no specific remedy for this disease, though many have been largely advertised and tested in practice, but much may be done to mitigate its severity and to aid recovery when medical advice is promptly taken. Wherever it occurs the best assistance obtainable should be resorted to without delay, for there are few diseases which more severely tax the ingenuity and resources of the physician. When an attack occurs the patient should be placed in bed, and the air in the bed-room should be kept warm and moist. Ventilation is necessary, but care must be taken to screen the sufferer from draught. Nutriment is urgently demanded, and strength should be maintained as far as possible by the administration of strong beef tea, milk, raw eggs, chicken broth, pounded raw beef, &c., and a little pepsine may be added to the food with advantage. Sometimes also the free administration of alcoholic stimulants becomes necessary, and where the stomach will not retain food or stimulants, they may be given in the form of enemata. Formerly it was customary to apply various caustics and solvents to the interior of the throat for the purpose of destroying the false membrane, but of late years the practice has been generally abandoned. Many physicians, however, still make use of mouth washes and gargles, or apply the officinal glycerine of borax by means of a camel's hair-brush. The application of moist warmth to the outside of the throat is very comforting to the patient, and is at any rate harmless. The drug on which the greatest reliance is placed in the treatment of diphtheria is iron, generally in the form of the solution of the perchloride. In cases where the patient is in danger of being suffocated through the obstruction of the air passages by false membrane, the operation of tracheotomy becomes necessary, and it is often attended with the best results.

After recovery from an attack of diphtheria there is frequently a paralysis of different parts of the body, and this is sometimes very severe, the palate, sight, limbs, and muscles of the neck or trunk being all liable to be affected. Sometimes the paralysis is sufficiently severe to cause death, but in nearly all cases there is a strong tendency to recovery. As diphtheria is contagious, care should be taken to avoid the breath of the patient, and it is a good plan to disinfect the discharges from the mouth and throat by means of carbolic and water, or other suitable disinfectant. The patient should be isolated as far as possible, and the attendants should carefully avoid inoculation with the products of the disease.

DIPH'THONG (Gr. *di*, twice, and *phthongos*, a sound) is the sound of two vowels pronounced in rapid succession, as the German *au* in *maus*, pronounced nearly like the English word *mouse*, the vowel sound consisting of the broad *a* of *father* followed quickly by the sound of *u* or *oo*. The *i* in the English word *mind* consists of two vowel sounds.

All diphthongs are said to be long syllables; and this would be true if they were only employed to mark the union of two vowel sounds. This probably was originally their sole office; for in many English words now written with diphthongs, but pronounced as if they had single vowels, an earlier pronunciation contained the double sound; and indeed this view is often supported by the provincial pronunciation of a word. For example, such words as *meat*, *dream*, are pronounced in many parts of England as dissyllables, *meät*, *dreäm*. In practice, however, a diphthong is often used where the vowel sound is not only uncompounded, but short, as in *friend*, *breadth*.

Again, diphthongs are occasionally used to represent simple sounds intermediate between the vowels, as in the English word *cough* and the German sounds represented by *ae*, *oe*, *ue*, commonly written *ä*, *ö*, *ü*, where the dots placed over the vowels are merely a corruption of the letter *e*.

DIPLO'MA is the term now generally applied to documents given by universities and other learned societies in proof of the holder having attained a certain degree, and to the licenses held by professional persons to practise their art. The word is derived from the Greek *diploo*, I double, from the ancient custom of writing solemn documents on two tablets of wax, which were doubled one upon the other.

DIPLOM'ACY is a term used either to express the art of conducting negotiations and arranging treaties between nations, or the branch of knowledge which regards the principles of that art and the relations of independent states to one another. The word comes from the Greek *diploma*, which properly signifies anything doubled or folded, and is more particularly used for a document or writing issued on any solemn occasion, either by a state or other public body, because such writings, whether on waxen tablets or on any other material, used anciently to be made up in a folded form. The principles and rules of diplomacy are embodied in numerous international customs, usages, and treaties, and to be a master of the art requires a man of great tact and good temper, ready in all social ceremonial to conform to the manners and customs of the people among whom he is resident. In the making of treaties and the arrangement of international ceremonies these qualities are put severely to the test, especially in connection with questions of precedence, which require the exercise of infinite tact. In the making of a treaty the usual practice is to make as many copies as there are parties to it. Each state gets a copy with precedence to its own name, and the other states follow in order on the principle known as the *alternat*, which is determined by lot. The precedence of the various states of Europe and of the United States of America in numerous other matters is settled by the same principle. Maritime international ceremonial is arranged by compact. [See SALUTE.] For the rights and duties of the several descriptions of functionaries employed in diplomacy, see AMBASSADOR and CONSUL.

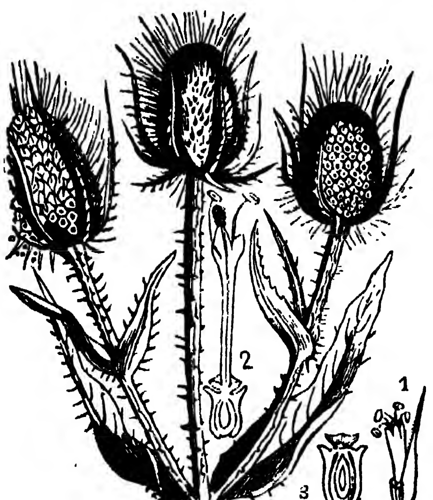
DIP'NOI is a group of FISHES of high importance as forming a connecting link between that class and the AMPHIBIA. Till lately the Dipnoi have usually been regarded either as falling under Amphibia or as a distinct order of fishes. The discovery in 1870 of a living representative of the extinct genus Ceratodus threw a new light upon the affinities of this group, to which Dr. Günther showed the newly-discovered species to be most nearly allied, while at the same time exhibiting the characters of a Ganoid fish. The result has been that the Dipnoi are now established as a suborder of GANOIDEI. The skeleton

is partially osseous, partially cartilaginous. The central gelatinous rod, called the notochord, which exists in all vertebrates in an embryonic condition, but is usually developed into a vertebral column, is persistent throughout life in this group. The skull is cartilaginous, with more or less extensive ossifications. The body is covered with small cycloid scales. The limbs—two pectoral and two ventral—consist of a central jointed axis, the joints bearing in Ceratodus jointed rays on each side. The limbs vary in shape, being filamentous in Lepidosiren and paddle-shaped in Ceratodus. The air-bladder is peculiarly modified, being partially or wholly divided into two cavities communicating with the œsophagus by an air-duct, and supplied (except in Ceratodus) with venous blood by a true pulmonary artery. These cavities act the part of lungs, enabling the fish to live out of the water. True, free, filamentous gills are also present. These fulfil the respiratory function under ordinary conditions, the lungs coming into play when the streams in which the animals live dry up. In the African Lepidosiren (Protopterus) three small external branchial appendages are present. Two molar teeth are found in each jaw, and the vomer is armed with two incisor-like teeth. Only three genera belong to this group, CERATODUS and the two genera LEPIDOSIREN and Protopterus.

DIP'PER. See WATER-OUSEL.

DIPSA'CEÆ, a natural order of plants, with monopetalous flowers, nearly allied to COMPOSITÆ. None of the species are of any importance except the common Teazle (*Dipsacus Fullonum*), whose prickly flower-heads are extensively employed in carding wool. [See TEAZLE.] Many of the species have handsome flowers.

Dipsaceæ is included by Bentham and Hooker in the cohort Asterales of GAMOPETALÆ, and are distinguished



Upper Part of Teazle (*Dipsacus Fullonum*).

1, a flower; 2, a corolla, with two of the stamens, and the ovary containing a pendulous ovule much magnified; 3, a longitudinal section of a fruit, with the pendulous seed and the inverted embryo.

principally by the following particulars: the flowers are irregular, each one surrounded by a calyx-like involucel, and usually collected into heads with an involucre; the corolla is imbricate; the anthers are free; the ovary is one-celled, with one pendulous ovule; the seeds generally have perisperm; the leaves are opposite, without stipules; the species are all herbs. There are about 120 species, natives chiefly of the Mediterranean region. None are found in America.

DIPSOMA'NIA (Gr., lit. thirst-madness), the name given to a now recognized form of disease, in which the sufferer is tormented by an irresistible or insane craving for intoxicating liquors—a craving absolutely uncontrollable by ordinary means. It is either innate or developed in some men—more rarely in women. Whatever be the cause, whether brought on by evil habits, or, as believed by some, hereditary, the man who becomes the subject of dipsomania is no longer a free agent, and should be dealt with accordingly. Institutions in which such persons are placed for a time under suitable restraint are well known in America, and to a less extent in the United Kingdom; but there is no law, unfortunately, by which physicians can compel drunkards to be sent there.

DIP'TERA (Gr. *di*, double; *ptera*, wings) is one of the orders into which INSECTS are divided. This name was first applied by Aristotle, and has subsequently been adopted by almost all entomologists, to designate those insects generally known as flies, the most striking character of which is the possession of two wings only. There are, however, among the Diptera some species destitute of

Achias maculipennis.

wings, as those of the genus Nycteribia, and the aberrant section Aphaniptera containing the flea.

The Diptera have six legs furnished with five-jointed tarsi, a proboscis, two palpi, two antennæ, three ocelli, and two halteres or poisers. The wings are membranous, and either naked or more or less clothed with hair. They are generally horizontal in their position, with nervures not very numerous, and for the most part longitudinally disposed. They have generally a small membranous appendage, the *alulet*, at their base. The proboscis is situated on the under part of the head; it consists of a sheath (or part analogous to the under lip or labium in mandibulate insects) serving to keep *in situ* other parts of the mouth, which when they are all present represent the mandibles, maxillæ, tongue, and labium. There are, however, considerable modifications in the structure of the proboscis; in some it is long, slender, corneous, and sharp, the number of inclosed pieces varying from two to six. The proboscis is a suctorial organ, and in many instances a piercing instrument also, as in the gnat and mosquito. The palpi are situated at the base of the proboscis. The antennæ are placed on the fore part of the head, and approximate at their base; they are generally small and three-jointed, the last joint being furnished with a bristle; but in some, as the Tipulidæ, they are long and composed of many joints; and in the Culicidæ they resemble little plumes. The eyes are generally large, especially in the males; in some species they are supported on peduncles which are prolongations of the sides of the head. The halteres or poisers, representing the hind wings of four-winged insects, are two small organs of a slender form, and furnished with a knob at their apex, situated at the base of the thorax on each side, and immediately behind the attachment of the wings. Their use is not decidedly ascertained.

Dipterous insects undergo what is termed a *complete*

transformation, the females producing eggs. To this rule, however, there are exceptions, for many change their skin before they assume the pupa state; and in some species of the genus Sarcophaga the eggs are hatched within the body of the mother, and are produced in the larva state; while in the Pupipara, not only are the eggs hatched within the body of the parent, but the larvæ continue to reside there until their transformation into pupæ.

The larvæ are footless grubs with a soft or leathery body. The head in some cases is not distinct, and can be retracted within the next segment. The pupæ are inactive, except in the gnats (Culicidæ). The Diptera may be divided into four sections or suborders—PUPIPARA, BRACHYCERA, NEMOCERA, and APHANIPTERA, the last very aberrant. The chief characteristic of Pupipara has been already noticed. It is a small section containing all parasitic forms, and the wings are often rudimentary or absent. The Brachycera (see Plate DIPTERA, figs. 1, 2, 4, 5, 7–10) contains the vast majority of these insects. It is characterized by the shortness of the antennæ, which consist often of only three joints. The Nemocera (figs. 3 and 6) have long thread-like antennæ, with from six to sixteen joints. The Aphaniptera (figs. 11–15), containing the flea and the chigoe, is a very peculiar group, sometimes ranked as a distinct order. The wings are abortive, and marked by two scales on each side of the thorax. The antennæ are very small.

The species are very numerous and widely diffused. Some of them may be called domestic, the house-fly being an example. Flies have in all ages attracted observation from the numbers in which they sometimes appear, and from the terror they excite by their well-known power of causing the most intense annoyance both to man and the lower animals. They are both animal and vegetable feeders. Their usefulness as scavengers is more than counterbalanced by their destruction of crops and the suffering some of them cause to man and his domestic animals.

DIPTEROCAR'PEÆ, an order of trees belonging to the cohort Guttiferales of the POLYPETALÆ. The different species produce a number of resinous, oily, and other substances; one, a sort of camphor (Dryobalanops); another, a fragrant resin; a third, gum-animi; while some of the commonest pitches and varnishes of India are procured from others.

The flowers of Dipterocarpus are large, white or pink, and deliciously fragrant. The pubescence is always stellate when present. The resinous juice of *Dipterocarpus trinervis*, a tree from 150 to 200 feet high, inhabiting the forests of Java, is made into plasters for ulcers and foul sores; and when dissolved in spirit of wine, or formed into an emulsion with white of egg, acts upon the mucous membranes in the same way as balsam of copaiba. *Dryobalanops aromatica* or *camphora* is the camphor tree of Sumatra. This order is distinguished from others in the same cohort by the flowers being hermaphrodite; the calyx enlarging as the fruit ripens; the stamens being numerous, or as many as the petals, or double or treble the number. The species are trees or shrubs, with undivided, alternate, coriaceous leaves, often with stipules, and the flowers in panicles.

DIP'TYCH, a folding double writing tablet, usually made of wood covered with wax. Diptyches were in use chiefly during the Roman and the early Christian periods.

DIR'CA, an American genus of plants belonging to the order THYMELACEÆ, with a single species, the *Dirca palustris*, which is remarkable for growing in watery places. It is found in the low woods of North America, bearing the severest cold and the greatest heat of the various parts of the United States. The fruit is a small oval, acute, red, one-seeded berry. The flowers are pale yellow. This plant is in all its parts very tough, and the twigs are used for making rods, the bark for ropes, baskets, &c. The bark is acrid, and in doses of 6 or 8 grains it produces heat in the stomach, and brings on vomiting. It also acts as a vesicatory when applied to the skin, and in small doses as a cathartic. The fruit possesses narcotic properties, and produces effects upon the system similar to those of Stramonium. There are eight stamens, inserted in two rows in the perianth; the ovary is one-celled, with one pendulous ovule.

DIRECT and **RETROGRADE**, in astronomy. The motion of the planets round the sun, of the satellites round their primaries, and of the bodies themselves round their axes, all take place in one direction, with the exception only of the comets, of which about one-half the whole number move in the contrary direction. The course of these celestial motions is always from west to east, which is the *direct* course. The *retrograde* is therefore from east to west. In the seventeenth century the direct motion was said to be *in consequentia*, and the retrograde *in antecedentia*. The most simple way of remembering direct motion is by recalling to mind the order of the signs of the zodiac. The diurnal apparent motion of the whole heavens—stars, sun, moon, and planets—from east to west is of course caused by the actual diurnal rotation of the earth from west to east on its own axis, and has nothing to do with the actual motions of the heavenly bodies. Thus the moon appears to move from east to west every night, but this is because the earth revolves. If the place of the moon among the stars be observed on two consecutive nights, she will be found to have moved to the eastward (direct) by nearly a twelfth of the whole visible sky, and by nearly an hour in time; and this represents the actual motion of the moon.

DIRECT and RETROGRADE, in music, are terms used in Imitation, in Canon, and in Fugue. See IMITATION.

DIRECTION, a relative term, not otherwise definable than by pointing out what constitutes sameness and difference of direction. Any two lines which make an angle point in different directions; a point moving along a straight line moves always in the same direction. Permanency of direction and straightness are equivalent notions. A body in motion not only changes its direction with respect to other bodies, but also the direction of other bodies with respect to it.

DIRECTOR. The management of banks, railways, gas companies, insurance companies, &c., is usually carried on by a number of persons who constitute the directorate or board of directors. In large and wealthy concerns the office is frequently sought on account of the influence, privileges, or emoluments attached to it. The position, however, is one of very considerable responsibility, and of late years there have been occasions on which directors of banks, &c., have incurred most severe penalties by negligence of duties the importance of which they had never seriously considered.

The statutory provisions relating to the office of director are contained in the Joint-stock Companies Acts, the principal one of which is 19 and 20 Vict. c. 47. The leading provisions are as follows:—That, first, directors shall be selected and their number determined by the subscribers of the original memorandum of association, who shall themselves be deemed directors until other directors are appointed. That the office of director shall be vacated by the acceptance of any other office or place of profit under the company, by bankruptcy or insolvency, or by being concerned in any contract with the company. There are provisions insuring the annual retirement of a proportion of the directors, and the election of others, or the reelection of the retired members. The company may reduce or increase the directorate, and may, in general meeting, remove any director. Minutes of the directors' meetings must be kept, setting forth clearly the name of each member present and the particulars of business transacted,

and such minutes must be signed by the chairman. The directors may, with the sanction of the company in a general meeting, declare a dividend, payable to shareholders in proportion to their shares. If, however, the directors declare a dividend when the company is insolvent, or one which, to their knowledge, would cause the company to become insolvent, they render themselves jointly and severally liable for all the debts of the company. Two directors are sufficient to sign a contract.

DIRECTORY. Under COMMITTEE OF PUBLIC SAFETY we have shown how the frightful excesses of the French terrorist faction led to their fall, and to the execution of Robespierre, Couthon, and St. Just in 1794. The moderate party in the National Convention then permitted the Abbé Sièyes to frame a new constitution, decreed 22nd August, 1795, comprising a legislative body divided into two councils—the Council of Five Hundred, whose function was to propose laws, and the Council of the Ancients, 250 in number, whose function was to pass them. The actual executive power of the republic was intrusted to five members chosen from both sections (1st November, 1795), and these five constituted the famous Directory. Their names were Lépeaux, Letournour, Rewbell, Barras, and Carnot. The new government was characterized, however, by the immorality and corruption, though not the cruelty, of the one it displaced. The demoralization, indeed, was greater than ever, in spite of the fact that France was menaced on every hand by foreign foes. The imminent danger of the country, and its absolute need of a firm and patriotic government caused the Abbé Sièyes to propose to several of the military leaders a plan for the overthrow of the Directory. Bonaparte was the only one who entertained the project, and probably the only one with sufficient popularity and boldness to carry it out. The idea of Sièyes was to set up a consulate which should be in reality a monarchy under republican forms. The conspiracy once entered into by Bonaparte, it was soon carried out; and on 9th November, 1799, the Directory was overthrown, and the Council of Five Hundred dispersed by Bonaparte at St. Cloud. The executive was vested in three provisional consuls, Sièyes, Ducos, and Bonaparte; and in the following December the CONSULATE began, Bonaparte as "first consul," Cambacérès and Lebrun his colleagues.

DIRGE, in music, a hymn for the dead. The word is a contraction of Lat. *dirige*, the first word of a Catholic funeral chant.

DIRT-BEDS are three beds of ancient soil occurring among the limestones and marls which constitute the lowest member of the Purbeck beds (Jurassic system) as developed in the Isles of Portland and Purbeck. They contain the silicified roots and stumps of conifers in great abundance, some of the stems still erect just as in life. There are also remains of plants allied to Cycas and Zamia, e.g. *Mantellia nidiformis* ("fossil birds' nests" of the quarrymen).

DISBUDDING, in horticulture, consists in removing the buds of a tree before they have had time to grow into young branches. It is a species of pruning which has for its object not only training, but also economy with regard to the resources of a tree, in order that there may be a greater supply of nourishment for the development of those buds which are allowed to remain. If the roots are capable of absorbing a given quantity of nutritive matter for the supply of all the buds upon a stem, and if a number of those buds be removed, it must be evident that those which remain will be able to draw a greater supply of sap and grow more vigorously than they otherwise would have done. This fact has furnished the idea of disbudding.

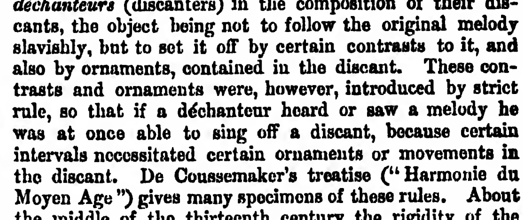
This kind of pruning has been chiefly applied to peach and nectarine trees; but the same principle will hold good with all others of a similar description, and might be practised upon them if they would repay the labour so expended.

DISC, in botany, a term signifying any ring or whorl of glands, scales, or other bodies that surround the base of an ovary, intervening between it and the stamens. In its most common state it is a fleshy wax-like ring, as in the orange; it frequently forms a yellowish lining to the calyx, as in the plum and cherry, and not unfrequently rises up like a cup around the ovary, as in the tree-pæony. The latter renders it probable that the disc is nothing but an inner whorl of rudimentary stamens. The presence of the disc is one of the characteristics of the DISCIFLORÆ. See Plate I., BOTANY, fig. 8*d*.

DIS'CANT (Lat. *Dis-cantus*, double song) was the older name for what we call counterpoint. The barbarous diaphony and ORGANUM which accompanied the subject at fixed intervals, a method unbearable by modern ears, seems to have become also distasteful to the men of the dark ages, who accordingly substituted for it the freer "discant." The art first arose in Paris in the twelfth century; and considerable freedom was aimed at by the *déchanteurs* (discanters) in the composition of their discants, the object being not to follow the original melody slavishly, but to set it off by certain contrasts to it, and also by ornaments, contained in the discant. These contrasts and ornaments were, however, introduced by strict rule, so that if a déchanteur heard or saw a melody he was at once able to sing off a discant, because certain intervals necessitated certain ornaments or movements in the discant. De Coussemaker's treatise ("Harmonie du Moyen Age") gives many specimens of these rules. About the middle of the thirteenth century the rigidity of the rules relaxed, freer motion was encouraged, and the art took the name of COUNTERPOINT.

DISCHARGER, THE ELECTRIC, or **DISCHARGING TONGS**, consists of a jointed brass rod with a glass handle to each arm. One knob of the rod (which ends in knobs at each end) being placed against the outer coating of a Leyden jar, and the other being put into connection with the inner coating by being brought very near the knob of the Leyden jar, the two diverse charges (positive and negative) rush together with a spark, and the jar will be found to be completely discharged.

Or if a metal sphere, *c*, be electrified and insulated by suspension from *d*, and two hollow hemispheres of metal, *a b*,



Biot's Experiment.

larger than the sphere, be brought together over it (each being insulated by a glass handle), then nothing happens till the internal surface of the hemispheres is allowed to touch the sphere at one point and for an instant, when the charge is at once transferred to the surface of the hemispheres, and the sphere is completely discharged. The reason of this lies in the fact that a charge of electricity resides always on the surface of the body, and directly the hemispheres touch the sphere the whole becomes electrically one body.

DIS'CIFLORÆ, in botany, is one of the divisions, according to Bentham and Hooker, of the POLYPETALÆ, comprising the following cohorts:—Geraniales, Olacales, Celastrales, and Sapindales. In the Disciflorae the calyx is generally free from the ovary; the petals are in one series; the stamens are definite, inserted on a disc.

DISCIPLINE, FIRST AND SECOND BOOKS OF. These are the names used to describe documents of great importance in the ecclesiastical history of Scotland. The First Book of Discipline was drawn up by John Knox and several of the most eminent Scottish reformers, in 1560. It contains the views of the reformers on the principles of the church, the permanent office-bearers of the church, and on various questions regarding modes of worship and the exercise of discipline. The Second Book of Discipline was framed by a committee of the General Assembly, and adopted by that body in 1578. Drawn up at a time when the civil and ecclesiastical rulers were in frequent collision regarding questions of jurisdiction, church government, and the like, it deals chiefly with these. Though neither of these documents were formally recognized by the state, they have ever been regarded as weighty and authoritative. Thus they are constantly appealed to in the ecclesiastical controversies which have so often agitated public opinion in Scotland.

DISCLAIMER. This word has various meanings, but those in ordinary use are the following:—

In an action, a defendant, in his answer to the plaintiff's claim, may disclaim all interest in the matter in question.

Where an estate is given, either by deed or will, to a person, he may by deed (which need not be enrolled, or, as it is called, made matter of record) disclaim all interest thereunder.

An executor is said to disclaim when he renounces probate of the will of his testator; and where the will contains a devise of lands to the executor, the disclaimer ought to be made by deed to afford evidence, in deducing a title to the lands, of the fact of disclaimer.

DIS'CO, an island in Baffin's Sea, off the west coast of Greenland, mean lat. 69° 30′ N., lon. 55° W., 70 miles long by about 40 broad. It forms an elevated plateau, which is covered with sheets of ice, and these discharge small glaciers seawards. The rocks of the island are gneiss and syenite in a small patch at the extreme south, trap on the west side, on the east coal and sandstone pervaded by trap rocks. This coal formation is of Miocene and Upper Cretaceous age, and has yielded 167 species of fossil plants and many insects, the vegetation as a whole being like that of California or the Southern United States.

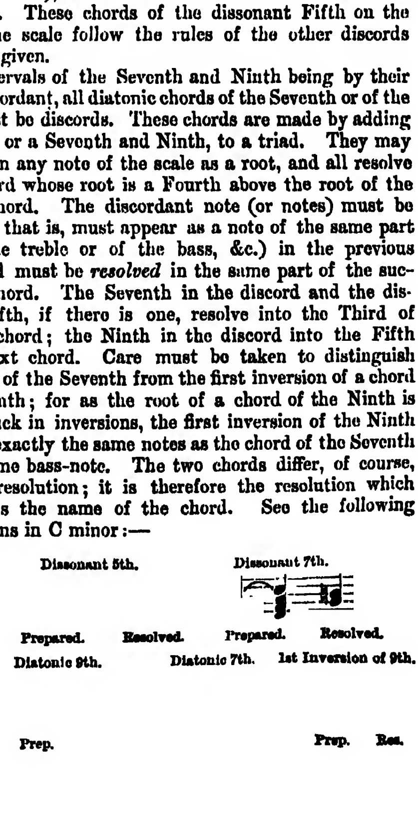
DISCOB'OLI is a small family of fishes belonging to the order Acanthopterygii, distinguished by the presence on the under surface of the body of a sucking disc composed of the united ventral fins. By means of this disc they attach themselves firmly to foreign bodies, such as rocks. This family only includes two genera, Cyclopterus [see LUMP-SUCKER] and Liparis, species of both being known on the British coasts.

DISCOMYCE'TES is a group of FUNGI belonging to the ASCOMYCETES. Among the genera are Morchella (Morel), Peziza, and Helvella. They are found growing on decaying organic matter. The spores are produced in elongated cells, called *asci*, which grow up from the fertilized female organ, the carpogonium. The carpogonia and pollenodia are produced on branches of the mycelium, which itself is the product of the asco-spores. The surface on which the asci appear (hymenium) is superficial.

DISCOPH'ORA is a name given to a subclass of the HYDROZOA. This name, since the great advances of recent years in knowledge of the Hydrozoa, has been replaced by Scyphomedusæ, a name which has reference to the development of the medusiform persons by transverse fission from a short hydriform polyp, originally described as a new organism under the name Scyphistoma.

DIS'CORDS, DIATONIC, in music. A discord is a note which must be resolved upon another note. Thus the interval of a Second is a discord, and must resolve itself into a Third before the ear can be satisfied. If C and D are struck together musical pain is experienced, and not relieved till the C falls to B or B♭, or the D rises to E♭ or to E. [See CONSONANCE.] All Seconds and Sevenths, and all augmented and diminished intervals are discords. [See AUGMENTED, DIMINISHED.] If a chord contains a discordant interval it is called also a discord, thus the word has two meanings. A discord, therefore, is either one note (or interval) or a chord containing such a note (or interval), but no confusion arises from this want of preciseness in diction. Diatonic discords might be held to mean intervals of discord found in the diatonic scale; and if this be the case the major scale will be found to contain Seconds, Sevenths, an augmented Fourth, and a diminished Fifth; while the minor scale contains in addition to these an augmented Second and diminished Seventh, an augmented Fifth and diminished Fourth, and an augmented Sixth and diminished Third. But the term diatonic discords is usually employed to denote certain chords which are compounded of the notes of the diatonic scale, and which nevertheless, as shown above, may contain discordant intervals, that is, may be discords. As a rule any triad in the scale (a triad being definable as a chord composed of three notes—a root, its Third, and its Fifth) is a concord, but the triad on the leading note of both major and minor has a diminished Fifth, and is therefore a discord (resolved as if it were the first inversion of the dominant Seventh with the root omitted); and the triad on the second of the minor key is similarly constructed. The first inversions of these triads are so smooth as to be considered concords. Not so the first inversion of the remaining "dissonant Fifth," that on the third of the minor scale, with its augmented Fifth, which is always a discord, whether in its root position or in an inversion. Day (supported by Professor Macfarren) desires the triad on the third of the major scale to be also treated as dissonant, but although much is to be said for his view (and certainly that treatment is the best, whether theoretically justified or not), musicians as a rule do not draw this distinction. These chords of the dissonant Fifth on the third of the scale follow the rules of the other discords now to be given.

The intervals of the Seventh and Ninth being by their nature discordant, all diatonic chords of the Seventh or of the Ninth must be discords. These chords are made by adding a Seventh, or a Seventh and Ninth, to a triad. They may be taken on any note of the scale as a root, and all resolve into a chord whose root is a Fourth above the root of the original chord. The discordant note (or notes) must be *prepared*, that is, must appear as a note of the same part (*i.e.* of the treble or of the bass, &c.) in the previous chord, and must be *resolved* in the same part of the succeeding chord. The Seventh in the discord and the dissonant Fifth, if there is one, resolve into the Third of the next chord; the Ninth in the discord into the Fifth of the next chord. Care must be taken to distinguish the chord of the Seventh from the first inversion of a chord of the Ninth; for as the root of a chord of the Ninth is never struck in inversions, the first inversion of the Ninth contains exactly the same notes as the chord of the Seventh on the same bass-note. The two chords differ, of course, in their resolution; it is therefore the resolution which determines the name of the chord. See the following illustrations in C minor:—



The root (C) of this first inversion of a diatonic Ninth is not struck; but the rise of roots by a Fourth, according to the rule, is observed to take place (C to F).

DISCORDS, FUNDAMENTAL. These are a series of chords formulated by Dr. Alfred Day [see DAY, DR.], which, discords though they be, yet need no preparation of their discordant intervals. The notes of the diatonic discords, treated of in the preceding article, will be found to vary in quality; according to their root they contain a major or minor or augmented Third, a perfect or diminished Fifth, &c. Not so the notes of the fundamental discords, whereof the discords on the dominant are at once the chief and the type. If chords be formed on the dominant by adding Thirds in the usual way, and if the notes of both the diatonic major and minor be used, the respective intervals of these fundamental discords, reckoned from the root upwards, according to the usual rule, will be found to be these:—They will contain a major Third, a perfect Fifth, a minor Seventh, a major or minor Ninth, a perfect Eleventh, and a major or minor Thirteenth; and then the chord recommences with the double octave or Fifteenth. Now other series of fundamental discords may be formed on the roots a Fifth below and a Fifth above the dominant; that is to say, on the tonic and the supertonic; but in each of these cases accidentals will be necessary to obtain the qualities of intervals possessed by the dominant type, and these qualities are imperatively necessary. The discords of the dominant are fairly to be regarded as diatonic, but the other two series are chromatic.

All these fundamental discords, in all three series, whether Sevenths, Ninths, Elevenths, or Thirteenths, may be taken without preparation, and have many different resolutions. It is evident, therefore, that they present striking differences from the older diatonic discords. The latter belong to the ancient style of harmony, admitting diatonic notes only, subjecting every note of the scale to the same laws, admitting no unprepared discords (except passing notes); whereas the modern style of harmony admits chromatic notes, treats the notes of the scale in various manners, and admits unprepared (fundamental) discords. The three series of fundamental discords resolve as follows:—

Dominant discords resolve on to the tonic chord and its inversions, on to inversions of the subdominant chord, or on to tonic and supertonic discords. *Supertonic discords* resolve on to the tonic chord or discords, or on to the dominant chord or discords. *Tonic discords* resolve on to the subdominant chord, followed by a chord characteristic of the original key (which might otherwise appear to have shifted to the subdominant), such as a dominant or supertonic discord; or on to dominant discords, or on to supertonic discords.

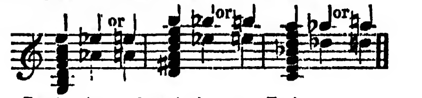
The separate intervals of fundamental discords have very various resolutions, unlike the Seventh and Ninth of diatonic discords, which simply fall a Second in every case. They are as follows:—In fundamental discords the Third must rise a Second, or remain, or fall a chromatic semitone (for example, if D be the Third, it must rise to E♭ or E♮, or remain, or fall to D♭, the chromatic semitone, that kind of semitone which does not change its name, as D to D♭); the Seventh must fall a Second, or remain, or rise a chromatic semitone; the major Ninth must proceed to the root or the Third, if the rest of the chord is still, otherwise it falls a Second, or remains, or falls a chromatic semitone; the minor Ninth the same, but *rising* a chromatic semitone; the Eleventh remains; the major Thirteenth proceeds to the Fifth or Seventh if the rest of the chord is still, but if the chord changes the major Thirteenth must fall a Second, remain, or fall a chromatic semitone; the minor Thirteenth the same, but *rising* a chromatic semitone.

The higher discords are rarely if ever fully expressed. Thus the commonest appearance of the chord of the Thirteenth is with the root, Third, and minor Thirteenth (the latter in its form of a minor Sixth); but the chord in this incomplete state yet requires the regular resolution for all its expressed notes. The chords of the supertonic major Ninth, and all the chords of the major Thirteenth, can only be taken in the major key. The other fundamental discords can be taken in both major and minor.

Some Resolutions of the Dominant 13th, Key C.

Major 13th. Minor 13th. Minor 13th.

Key of C.—Fundamental discords fully expressed.



Dominant. Supertonic. Tonic.

Key of C.—Fundamental discords.

Tonic fundamental discord (root position of the tonic 7th) resolving on to supertonic discord (last inversion of supertonic 7th), and thence on to dominant discord (first inversion of dominant 7th), which resolves on to the tonic common chord.

DIS'COUNT, a sum of money deducted from a debt in consideration of its being paid before the usual or stipulated time. The circumstance on which its fairness is founded is that the creditor, by receiving his money before it becomes due, has the interest of the money during the interval. Consequently he should only receive so much as, put out to interest during the period in question, will realize the amount of his debt at the time when it would have become due. For instance, if £100 is to be paid at the end of three years, what should be paid now, interest being 4 per cent.? That is to say, since £100 under the circumstances would be the fair present value of £112 due in three years (interest being 4 per cent.)—for £100, if invested at simple interest, would produce £12 interest in that time, and thus become £112—the problem is to find what sum would in like manner produce sufficient interest to raise it to £100. Or, in another way, what sum bears the same relation to £100 that £100 does to £112? This is a simple "rule of three" sum—

$$£112 : £100 :: £100 : x.$$

The answer is £89 5*s*. 9*d*., the present value of the £100. The true discount is therefore £10 14*s*. 3*d*. In practice, it is usual not to find the real discount, but to allow interest on the whole debt in the shape of abatement. Thus it would be considered that, in the preceding example, three years' discount upon £100 at 4 per cent. is £12, or £88 would be considered as the present value.

In transactions which usually proceed on compound interest, as in valuing leases, annuities, &c., the principle of discount is strictly preserved.

The name of discount is also applied to certain trade allowances upon the nominal prices of goods. In some branches of trade these allowances vary according to the circumstances which affect the markets, and what is called discount is in fact occasioned by fluctuations in prices which it is thought convenient to maintain nominally at unvarying rates.

The term discount is also employed to signify other mercantile allowances, such for example as the abatement of 12 per cent. made upon the balances which underwriters, or insurers of sea-risks, receive at the end of the year from the brokers by whom the insurances have been effected. The word discount is further used, in contradistinction to premium, to denote the diminution in value of securities which are sold according to a fixed nominal value, or according to the price they may have originally cost. If,

for example, a mining or banking share upon which £100 has been paid is sold in the market for £98, the value of the share is stated to be at 2 per cent. discount.

DIS'CUS (Gr. *diskos*), a quoit of stone, brass, or iron, with which the Greeks and Romans diverted themselves in the public games. The discus, when perforated like our modern quoit, was thrown by the help of a thong put through the middle of it. It was at other times of a solid piece, and was then hurled directly from the hand. This last method is illustrated by Myron's discobolus, or quoit-thrower, one of the glories of the Vatican antiques.

DISINFEC'TANTS are substances used to purify the air of those noxious products which are evolved from putrescent matters and also from persons suffering from contagious disorders like small-pox, scarlet fever, measles, typhus fever, diphtheria, &c. These germs float about in the atmosphere, and not only spread the disease among those in the immediate vicinity, but they may be easily carried to other localities, and there set up fresh centres of disease. It is therefore very important to use such measures as may be calculated to destroy these germs, and so diminish the propagation of the disorder. The principal disinfectants are chlorine, the chlorides of lime and soda, chloride of zinc, ozone, carbolic acid, the alkaline manganates and permanganates, peat charcoal, the fumes of nitric, nitrous, and sulphurous acids, dry heat, and ventilation. The last two are the most efficient and easily applied. The clothing, bedding, &c., of patients labouring under contagious diseases may be effectually disinfected by exposure for about an hour to a temperature a little higher than that of boiling water. Neither the texture nor colour of textile fabrics is injured by a heat of even 250° Fahr. It is a practice at many workhouses to bake the clothes of the paupers who have the itch, or who are infested with vermin. Quicklime rapidly absorbs carbonic acid, sulphuretted hydrogen, and several other noxious gases, and is therefore commonly used as a wash for the walls of buildings. Acetic acid, camphor, fragrant pastilles, cascarilla, brown paper, or other similar substances, are frequently burnt for the purpose of disguising unpleasant odours. The sulphates of iron and lime have the property of rapidly destroying noxious effluvia. A quantity of either of these sulphates thrown into a cesspool, for instance, will in a few hours render the matter therein quite scentless. Of gaseous disinfectants, sulphurous acid gas (obtained by burning sulphur) is preferable on theoretical grounds to chlorine. No agent checks so effectually the first development of animal and vegetable life. All animal odours and emanations are immediately and most effectually destroyed by it. Practically, however, it is very offensive, and, when freely used, dangerous. Chlorine, as given off by chloride of lime, and carbolic acid, are therefore more often used in the sick chamber, both these being excellent means of preventing the spread of infection and of sweetening the air. A solution of one or other of them should be immediately poured upon the evacuations of cholera or typhoid-fever patients. Condy's fluid is one of the most valuable disinfectants for use in case of fever. It consists of solutions of the alkaline manganates and permanganates. Burnett's disinfecting liquid is a solution of chloride of zinc. Nitrate of lead constitutes Ledoyen's, and a solution of a persalt of iron is said to constitute Ellerman's deodorizing fluid. See also ANTISEPTICS and DEODORIZERS.

DISINTEGRA'TION is a term used in geology to denote the gradual breaking and grinding down of the hard and compact parts of the earth's surface. Boulders, shingle, pebbles, gravel, sand, and dust are different degrees of fineness to which this grinding has at any given time been carried—different stages in a process which is perpetually going on, and which is slowly but surely reducing the hardest rocks to powder. Various agencies are at work helping to produce this result; their action will be briefly considered. Water has, in various ways, a powerfully disintegrating action. In falling as rain it wears the surface on which it falls, and though the effect of one shower on a hard rock may be so small as quite to escape observation, the effect of such showers acting through many ages is by no means insignificant. And we must take into account not only the mechanical wear and tear, but also the solvent powers of the rain-water, these powers being frequently increased by the fact that it holds a certain amount of carbonic acid in solution, and is thus able to act on limestone and chalk, which are insoluble in pure water. The wash of the rain also carries away the loose covering of soil on many rocks, and thus exposes a fresh surface to disintegration. The rain, collecting into brooks, streams, and rivers, has a considerable erosive action, the nature and extent of which are touched upon under the head of DENUDATION. The Falls of Niagara and the cañons of the Colorado may be mentioned as instances of the erosive action of rivers on a large scale. In the case of the falls the river has cut a gorge of 7 miles from the plain to the waterfall itself; the rock cut through is a compact limestone resting on soft shales. The shales have been worn away by the river, and their excavation has left the jointed limestone above unsupported; great masses of the latter have accordingly fallen down, and been broken up and washed away. A very interesting point about the Niagara gorge is the fact that it starts from an escarpment produced by subaerial disintegration, and its length represents the amount by which river disintegration has exceeded atmospheric disintegration in rapidity. The river is eating its way back at the rate of 8 feet every year, according to Bakewell. The Colorado gorges or ravines (locally called cañons) are on an enormous scale; the Grand Cañon of the Colorado is 800 miles long, and in some parts over 6000 feet deep, this depth representing the furrowing of the plateau by the Colorado River.

A great portion of the rain that falls sinks into the ground, and, when accumulated in sufficient quantities, forms springs. These, by their solvent action, greatly assist disintegration, and their action is greater than that of rain, since they come into more intimate contact with the rocks on which they act, and have a much longer time in which to act upon them. Spring water often has a large quantity of carbonic acid in solution, and this enables it to act energetically on limestone. Water in districts where there is chalk or limestone is almost invariably "hard," from the amount of carbonate of lime it holds in solution; this of course means the removal of a large quantity of limestone, and occasionally the ground above breaks through by its weight into the hollows formed by the abstraction and removal of the underneath rock by springs. The removal of chalk in this fashion causes the frequent slipping of the gault in some places, whence the local name of "blue slipper" for the gault clay. A similar action has produced the so-called "under cliff" of the Isle of Wight. Water in the form of ice exerts a powerful disintegrating action, both in the act of freezing and when frozen. When freezing water expands considerably. Hence the water that gets into the cracks and hollows of a rock on freezing widens the rent in which it is, or even breaks off large masses of the rock. Again ice, in the form of glaciers, grinds down the surface of the country over which it moves. This is proved (1) by the smooth polished condition of rocks over which a glacier has passed, (2) by the turbid condition of the streamlets that run from under a glacier. Lastly, as moisture in the air, water helps on the work of disintegration by enabling the carbonic acid of the air to attack and decompose silicates. It is thus that granites are decomposed into kaolin and sand, and in fact to this is due a very large part of the phenomenon of "weathering." Granite will last for ages in a dry Eastern

climate, but would be but an indifferent building stone in Ireland. The erosive action of the sea on the land has already been spoken of under DENUDATION; the slips constantly taking place on our eastern and southern coasts furnish us with excellent examples of its extent.

Change of temperature is frequently the cause of considerable disintegration, but its action is only noticeable in countries where the diurnal range of temperature is very marked. Livingstone records that in some parts of Africa, where the rocks are heated up to 187° Fahr. by the sun during the day, the cooling at night is so great and rapid as to cause a sudden and considerable contraction, occasioning a strain which is too great for the rocks; they split in all directions, throwing off fragments which sometimes are nearly 200 lbs. in weight. Lightning frequently breaks and shatters rocks, especially in exposed positions. Earthquakes break and crush rocks on an enormous scale, but only occasionally and locally. Wind has been known to grind and polish rocks by driving sand against them, notably in Arabia. That this action is not inconsiderable is proved by the fact that the windows of some houses built near Cape Cod were in a short time reduced to ground glass by these means. The abrading effects of the wind-blown sand are painfully seen on those Egyptian monuments which are exposed to the drift from the Libyan desert. This power of sand is now used in the mechanical arts in the form of the sand-blast. Patterns are etched away from a protected ground on a piece of glass with marvellous rapidity by a fine stream of sand driven forcibly through a nozzle. The sand-blast is also used for boring, but as yet its use in this respect has not been fully developed. Plants aid in disintegration (1) by keeping the surface of rock, &c., moist, as in the case of mosses; (2) their roots often widen clefts and rents in rocks, sometimes even splitting pieces off, while they open up the soil so that air and moisture can more readily get at it; (3) their decay gives rise to organic acids, which often have considerable chemical action on the soil. Again, forests undoubtedly cause a greater rainfall over the area which they cover than would occur if there were no trees on the space in question. Animals often have no small effect in aiding disintegration. The earthworm has had enormous influence by abrading the coarser particles of soil passing through its body; burrowing animals have loosened large quantities of earth, enabling it to be more easily removed, and thus helping to expose new surfaces. Beavers have been known to divert streams by their dams, and in North America cases have occurred where streams thus turned aside have flooded valleys, sediment has been deposited in the lakes thus formed, and ultimately has filled them up, causing the formation of thousands of acres of meadow-land. Crayfish have been known to weaken the banks of the Mississippi so far that the river has burst through and inundated the country round. Several shell-fish are known to bore and pierce even the hardest rocks.

The accumulations of disintegrated material would protect the underlying surface were they not continually being removed by wind, rain, streams, &c. Fresh surfaces are thus constantly being exposed, disintegrated, and denuded away by forces which are acting ceaselessly. The grinding down and removal of the largest and hardest masses of rock is only a question of time.

DISLOCATION. Various parts of the body are liable to be displaced by the direct application of violence, or by more gradual causes. But the term *dislocation* is commonly appropriated to displacements occurring in connection with the joints.

The injuries classed under this title may be effected by external violence, or by the undue contraction of muscles, or by both of these causes combined; and they result in some instances from disease within the joints themselves, by which their ligaments are weakened or destroyed, and their sockets rendered insecure by ulceration and other gradual changes.

When, by the protrusion of the bone through the skin or otherwise, the dislocation is complicated with an external wound exposing the cavity of the joint, it is said to be *compound;* and, as in the parallel case of fracture, this aggravation of the injury is very serious, and the most skilful management is required to save the life or limb where the injury happens to one of the larger joints.

The particular dislocation takes its name either from the joint itself or from the furthest bone; and various terms are added to indicate the direction of the displacement, or the new situation of the head of the bone. Thus the most common form of the accident at the hip is called "a dislocation of the head of the *femur*" (thigh-bone) "*backwards* upon the *dorsum ilii*" (flat part of the haunch-bone).

Any bone may be displaced in any direction, but the accident happens most frequently in those joints and directions in which the extent of motion is the greatest. Thus the most common dislocation is that of the shoulder, which is the most movable joint; and its most frequent variety is that in which the head of the *humerus* (or bone of the upper arm) is drawn downwards into the *axilla* (or arm-pit) by the sudden contraction of certain strong muscles. This dislocation is shown in figs. 1 and 2 of Plate. The simplest mode of accomplishing its reduction is shown in fig. 6. The patient being laid on his back, the operator places his heel in the armpit as shown, grasping the wrist with both hands and pulling the arm steadily downwards. When it is thus well extended he finally bends it inwards over the fulcrum supplied by his foot, when the bone slips into its socket with a snapping sound. When help is not at hand a determined man may even reduce such a dislocation himself with the aid of a gate, as shown in fig. 3, by grasping a bar with the hand and stretching the disabled arm over the top bar.

The jaw is sometimes thrown out of joint by the mere act of yawning. This accident may be relieved immediately by any bystander wrapping a napkin round his thumbs and placing them firmly against the back teeth, so as to press them downwards, while with the fingers and palms the chin is steadily raised and pushed backwards. Another mode of reduction is shown in fig. 5. Dislocation of the thigh at the hip-joint may be reduced in the same way as recommended for dislocated shoulder. The operation is shown in fig. 7, but considerable strength as well as skill is required to carry it out successfully.

The reduction of a dislocated bone is effected by a process technically called *extension*, consisting of the application of force in a proper direction, and steadily kept up till the muscles are fatigued. The head of the bone is thus drawn down a little below the level of the joint, and, being lifted over the edge of the socket, slips easily into its place upon slightly relaxing the extending force.

DISMAL SWAMP, a morass of the United States, commencing south of Norfolk, Virginia, and extending for 30 miles into North Carolina. It is 10 to 12 miles broad, and is covered with reeds or trees with underwood. The prevailing trees are cypress, juniper, and white cedar, and on the higher ridges oak and beech. It is a peculiar feature of this swamp that except on the western side it is higher than the surrounding country. About the centre is Drummond's Lake, 6 miles long and 3 wide. The transit has been facilitated by canals, one of which traverses it lengthwise, and connects New Lebanon in North Carolina with Norfolk in Virginia. In Virginia two lines of railway pass along the outskirts. This swamp is known as the Great Dismal Swamp, to distinguish it from another swamp in North Carolina between Albemarle Sound and Pamlico Sound, which in the slave days was a frequent refuge of escaped slaves.

DISMISSAL, in military affairs, the discarding of a soldier from the British service. There are two modes of dismissal—the one specific and the other general. When an officer is dismissed specifically, it is implied that he is rendered incapable of ever serving again in the army. This species of dismissal is usually attended with public marks of degradation or disgrace; and when it is the result of a court-martial, the party is said to be *cashiered*. When an officer is dismissed generally, it is by a simple intimation that the sovereign has no further need of his services, the dismissal of a soldier without explanation or trial being a part of the royal prerogative.

DISPART′, in gunnery, is the difference between the semidiameter of the base-ring at the breech of a gun and that of the ring at the swell of the muzzle. It depends, therefore, upon a relation between the diameter of the breech and that of the muzzle of a gun; and the object in ascertaining it is to aid the gunner in obtaining a line of sight truly parallel with the axis of the bore.

DISPEN′SARY, an institution supported by voluntary contributions for supplying the poor with medical and surgical advice, and with medicines gratuitously. Institutions of this kind are only of recent origin. They differ from hospitals in this, that the sick, when too ill to attend personally at the institution, are visited at their own homes by the medical officers of the charity. The medicines, which are commonly purchased in considerable quantities at a time and at wholesale prices, are dispensed in inexpensive forms, and in this manner the extent of the relief afforded is great while the cost is trifling. Few institutions afford so much real assistance at so small an expense. A still more recent development is that of self-supporting dispensaries, by which, in times of illness, competent medical attendance and a supply of medicine is obtained by payment of a small weekly fee. The term is also used by medical men to indicate the apartment in which their medicines are kept and made up or dispensed as required.

DISPEN′SING POWER, THE, is part of the royal prerogative of mercy, and consists in the dispensation of certain persons or classes of persons from the incidence of certain laws. The abuse of this power was the subject of petition even in Plantagenet times, as, for instance, under Edward III. in 1330, 1347, 1351, &c. The House of York used it freely in favour of those whose favour it wished to gain or to retain. The Tudors did not let so royal a privilege slip, and the Stuarts used it so that it caused their ruin; for at length the judges under Charles II. (being outraged by the frequent and capricious use of this power) took to deciding that the king had no power to dispense with what is *malum per se*, nor with statutes made for the general good, nor with the right of a person or body of persons. But by shameful means James II., to permit him to extend that protection to his hated coreligionists, the Catholics, which the laws of England did not allow, procured a judgment from Lord Chief-justice Herbert (1686), that the "laws of England were the king's laws, and that he could dispense with any of them." The gross abuse James made of this dispensing power, and the general DECLARATION OF INDULGENCE in 1688 cost him his crown. On the accession of William and Mary the BILL OF RIGHTS expressly forbade the sovereign ever in future to assume the dispensing power "as it hath been assumed and exercised of late."

DISPERSION OF LIGHT. See LIGHT.

D′IS′RAELI, ISAAC, D.C.L., F.S.A., &c., the celebrated literary historian, and father of the Right Hon. Benjamin Disraeli (afterwards Lord Beaconsfield), was born at Enfield in 1766. He received the greater portion of his education abroad, and acquired a knowledge of several modern languages. In 1791 he brought out his first volume of the "Curiosities of Literature; consisting of Anecdotes, Characters, Sketches, and Observations, Literary, Critical, and Historical." The "Curiosities" were gradually increased to three volumes, and a second series was published in 1823. They were remodelled and improved in various editions, and reached their twelfth impression in the year 1841. In 1812 and 1813 appeared his "Calamities of Authors, including some Inquiries respecting their Moral and Literary Characters;" in 1814, "Quarrels of Authors; or, some Memoirs for our Literary History, including Specimens of Controversy, to the Reign of Elizabeth." In 1816 appeared his "Inquiry into the Literary and Political Character of King James I." On these works, and more particularly "The Curiosities of Literature," will rest D'Israeli's most enduring reputation; but he derived more temporary popularity from his "Commentaries on the Life and Reign of Charles I." For this production the University of Oxford conferred upon him the honorary degree of D.C.L. as a testimony of their respect. In 1839 he was stricken with blindness. Nevertheless, with the aid of his daughter, he gave the world some notices of the early period of our literary history, under the title of "Amenities of Literature." D'Israeli was a contributor to the early numbers of the *Quarterly Review*. His review of "Spence's Anecdotes" in 1820, and a vindication both of the moral and poetical character of Pope, produced the famous Pope controversy, in which Mr. Bowles, Lord Byron, and others took part. He died in 1848. D'Israeli was a Jew, but upon some disagreement in business matters of the synagogue with his coreligionists he ceased to attend service, and became careless of religious affairs. A friend having asked permission to procure baptism for his son Benjamin, the elder D'Israeli allowed the youth in this manner formally to enter the Church of England, or rather he did not care enough about it to oppose his friend's action. Benjamin Disraeli was therefore a Christian from his childhood. He altered the spelling of the family name by omitting the apostrophe, but he never sought to disguise or to renounce his Jewish origin.

DISRUP′TION, the name given in Scotland to the great breach made in the Established Church in 1843, when more than 400 ministers left that church, and took the name of the "Free Church of Scotland." By the use of the word "*disruption*" the members of this church wish to show that the act was not one of *secession* from the Established Church, but of *a division within it*. See FREE CHURCH.

DISS, a market-town of England, in the county of Norfolk, on the Great Eastern Railway, 94 miles from London, and 19 S. by W. from Norwich. The town is irregularly laid out on a very uneven site, but contains many good houses. There are twelve principal streets, well paved and lighted. The manufactures are brushes, yarns, and hosiery, but the most important business of the town is agricultural. The lake or mere, at the foot of the hill on which the town is situated, covers about 7 acres, and is 17 feet deep. Its banks are laid out in ornamental gardens. The church, an ancient Gothic building, has recently been partly restored, and some stained-glass windows inserted. There are numerous dissenting chapels, and a corn exchange. The population in 1881 was 3846.

DISSEC′TION, the art of separating the parts of organized bodies in such a manner as to display their structure. It is an art equally applicable to both divisions of the organic kingdom, and indispensable alike to the discovery of the structure of plants and animals. For the well-being of the community every facility should be afforded for the cultivation of this art. It is satisfactory to observe that the prejudices which formerly obstructed this practice are rapidly disappearing, and even the most uneducated are beginning to appreciate its great importance and its signal utility. At the same time the legislature has seen fit to prevent the dissection of living animals except under very stringent regulations. See VIVISECTION.

DISSENT'ERS, the general name for the various Protestant religious sects in this country that disagree in doctrine, discipline, or mode of worship with the Established Church. The Jews and Roman Catholics are not commonly called dissenters. Formerly the leading classes of dissenters were the Presbyterians, the Independents, the Baptists, and the Quakers, and they still continue to be the most numerous, except the Methodists, or followers of Wesley and Whitefield, most of whom are now avowedly dissenters, and are subdivided into Wesleyan Methodists, Primitive, and some others. Formerly many of the Methodists repudiated the name of dissenters, and the Church of England Prayer Book is still used in some chapels. Of the minor sects many may be considered as only subdivisions of or included in the four leading denominations. The most numerous classes of dissenters in Scotland are the Free Church and the United Presbyterian Church, to which nearly two-thirds of the entire population belong. Since the disestablishment of the Protestant Episcopal Church in Ireland, in 1871, the term dissenter has, of course, become obsolete in that country. It is essentially an English word, although its almost exact equivalent may be said to have existed in Poland, in the name of *dissidents*, a term which first appears in the acts of the Warsaw Confederation of 1573, and there denotes the Polish Protestants, in contradistinction to the Roman Catholics. After 1632 the term dissidents was applied in Poland to all who were not Roman Catholics, such as Lutherans, Calvinists, Greeks, Arminians, &c. See NONCONFORMITY.

DISSEP'IMENTS, the partitions in the inside of a fruit, which are formed by the union of the sides of its constituent carpels. Dissepiments are therefore necessarily alternate with the stigmas.

DIS'SONANCE. See CONSONANCE.

DISTEM'PER is a corruption of the word *tempera*, the most ancient method of painting, in use before the invention of oil-painting, and wherein the colours were "tempered" or mixed with and diluted by a "medium" to a proper consistence. Sometimes early (tempera) paintings are incorrectly said to be "in distemper," but the use of the word is now limited to painting in body colour, as in scene-painting. True tempera will be found described in the article PAINTING. In the distemper of scene-painting and house-decoration the medium is weak glue or size, and the colours are mixed in a "body" of thin plaster of Paris or whiting.

DISTEM'PER, a disease which affects young dogs generally between the third and sixth months of their age, but which sometimes occurs at other periods. It consists of a typhoid inflammation, often very acute in its earlier stages, the nervous system and the respiratory passages being chiefly affected. It is contagious in its character, spreading from one dog to another, but it never attacks the same dog twice. The earliest symptoms of the disease are dulness, dislike for exertion, and a reduction in temperature. These are followed by feverish symptoms, the eyes become weak and watery, the nose dry and hot, and there is often a good deal of coughing and sneezing. As the disease progresses the air passages and the lungs become affected, and the dog becomes weak and liable to convulsions and fits. Among highly bred and delicate dogs the distemper is a very fatal complaint, but the more hardy varieties, if properly treated, generally recover. Treatment consists in relieving the stomach and bowels by the aid of emetics and aperients, in keeping the dog dry and warm and on a light diet of bread and milk. The discharge from the eyes and nostrils should be sponged away with a little tepid water, and when breathing is difficult a cloth wrung out of hot water may be wrapped round the chest. The dog should be well looked after and warmly housed for some time after an attack, or the disease may leave behind some permanent affections.

DIS'THENE or **KY'ANITE** (also spelt *Cyanite*), a mineral found in long flattened prisms belonging to the Triclinic system, generally pale to dark blue in colour, some varieties white to gray. It has a hardness of 5 on the lateral planes and 7·25 on the basal plane, and to the circumstance of its possessing this marked difference of hardness in two directions it owes its name of *disthene* (the name being derived from the Greek *dis*, twice, and *sthenos*, strong; while *kyanite* is from the Greek *kuanos*, blue). In composition the mineral is normal silicate of alumina, $Al_2O_3, 3SiO_2$; its specific gravity varies from 3·45 to 3·7. The transparent blue crystals are often used as a gem; they somewhat resemble sapphire. The mineral is found at Botriphnie and Banchory in Scotland, in Donegal, on the St. Gotthard, at Greiner and Pfitsch in Tyrol, and in many other parts of Europe and America.

DIS'TICH (Gr. *distichos*, consisting of two rows or ranks) is a word generally applied to a couplet, or two poetic lines. German poets have frequently adopted the distich for the expression of epigrams, or for single thoughts and sentiments.

DIS'TICHOUS, a term in botany, signifies arranged in two rows, as the grains in an ear of barley and the florets in a spikelet of quaking-grass.

DISTILLA'TION is a chemical process for applying a regulated heat to fluid substances in covered vessels, in order to separate their more volatile constituents in vapour, and for condensing this again immediately by cold into the liquid state. The distillation of aromatic waters was known to the Greeks and Romans, and to the Arabians from very remote times. Arnoldus de Villa Nova and Raymond Lully both noticed, in the thirteenth century, a mode of producing intoxicating spirits by distillation. The alchemists of those days imagined that spirit derives its ardent qualities from the fire employed to heat the vessels. The oldest form of distilling apparatus was the alembic, now superseded by the retort and Liebig's condenser. On the large scale stills of copper heated by steam and connected with worm-tub condensers are usually employed.

The only substances employed in this country in the manufacture of ardent spirits upon a great scale (which is the chief example of distillation) are different kinds of corn, such as barley, rye, wheat, oats, buckwheat, rice, and maize. Sugar and molasses have also been occasionally used in small quantities. The principles in these grains from which the spirits are indirectly produced are starch and a little sweet mucilage, which, by a peculiar process called *mashing*, are converted into a species of sugar called glucose. It is the sugar so formed which is the immediate generator of alcohol, by the process of fermentation. In mashing one or more kinds of corn a greater or smaller proportion of malt is always mixed with the raw grain, and sometimes malt alone is used, as in the production of malt whisky. The diastase of the malt is sufficient to convert the starch of a considerable quantity of other grain into glucose.

The manufacture of ardent spirits consists of three distinct operations—first, mashing; second, fermentation; third, distillation.

Mashing.—Either malt alone, or malt mixed with other grain and coarsely ground, is put into the mash-tun along with a proper proportion of hot water, and the mixture is subjected to agitation by a mechanical revolving apparatus. The water is applied at a temperature varying from 145° to 165° Fahr. After two or three hours' agitation, the whole is left to repose for an hour and a half and then the worts (as the liquor is called) are drawn off to about one-third the volume of water employed, the rest being entangled in a pasty state among the farina. About two-thirds of the first quantity of water is now let into the tun, but at a temperature somewhat higher, and the mashing motion is renewed for nearly half an hour. A

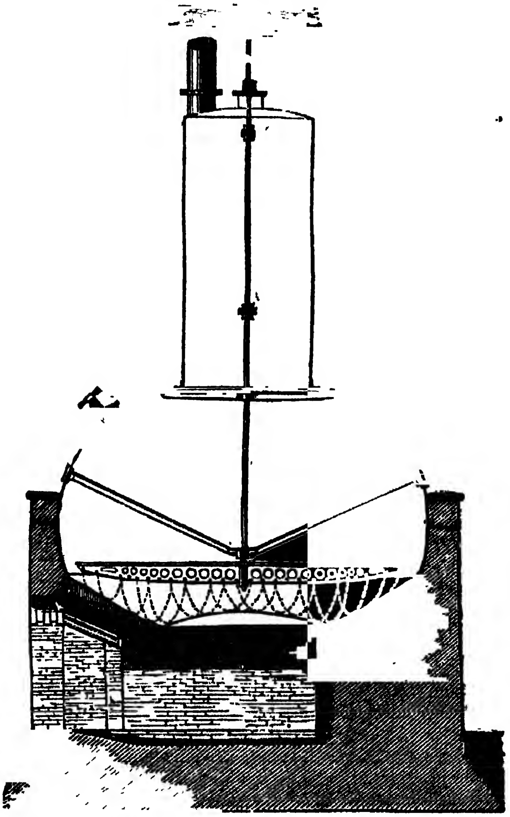
second period of infusion or repose ensues, after which these second worts are drawn off. Both infusions must be cooled as quickly as possible down to about 75° Fahr.; this is usually effected by exposing the wort for some time in large shallow cisterns, called coolers, freely exposed to aerial currents; but the liquor is sometimes cooled by being passed through serpentine tubes surrounded with cold water, or by the agency of ventilators blowing over its surface in extensive cisterns only 3 or 4 inches deep. A third mashing is conducted with a fresh portion of water, in order to extract the remaining saccharine matter from the grain.

The specific gravity of the first and second worts, when mixed, is about 1·060; and the liquor contains about 60 lbs. of saccharine extract per barrel of 36 gallons. The three mashings employ about 27 gallons of water to every bushel of ground meal.

Fermentation.—This consists in bringing the worts to a fermented state. The worts are drawn off into a fermenting vessel, and yeast or ferment is added, sufficient to decompose the sugar in the liquor. The process is commenced at a temperature between 60° and 70°, which soon afterwards rises to 85° or 90°. The first appearance of fermentation shows itself by a ring of froth round the edge of the vat usually within an hour after the addition of the yeast; and in the course of five hours the extrication of carbonic acid from the particles throughout the whole body of the liquor causes frothy bubbles to cover its entire surface. The yeasty froth begins to subside in about thirty-six hours, and when the attenuation gets more advanced the greater part of it falls to the bottom, on account of its density relatively to the subjacent fluid. In from forty-eight to sixty hours the liquor begins to grow clear, and becomes comparatively tranquil. It is stirred up occasionally during the fermentation, and the vessel is kept mostly closed after the first violence of the action. The specific gravity of the liquor diminishes as the process advances; the fermentation converts the sugar into alcohol or spirit, and as the alcohol is lighter than water it diminishes the specific gravity of the whole. The liquor itself is now called *wash*. One hundred gallons of this wash contain about 12 gallons of proof spirit; if the whole of the sugar were decomposed (which it never is in practice), the produce of spirit would be greater. In the great distilleries, where the quantity of liquor operated on at once is very large, the duration of the fermenting process is longer than that above named.

Distillation.—Great distilleries are usually mounted with two stills, a larger and a smaller. The former is the *wash* still, and serves to distil from the fermented worts a weak crude spirit called *low wines;* the latter is the *low-wine* still, and rectifies by a second process the product of the first distillation. In these successive distillations a quantity of fetid oil, derived from the corn, comes over along with the first and last portions received, and constitutes by its combination what is styled the strong and weak *faints*. These milky faints are carefully separated from the limpid spirit by turning them as they begin to flow from the still into distinct channels, which lead to separate *receivers*. From these receivers the various qualities of spirit, low wines and faints, are, for the purpose of redistillation, pumped up into charging backs, from which they are run in gauged quantities into the low-wine and spirit still.

The distilling apparatus where the old form of still is in use, is thus arranged:—The wash is conveyed through pipes from the fermenting vessel to the wash charger, which is a closed iron cistern capable of containing 80,000 gallons. From this vessel the wash flows into the wash-still, a copper vessel holding 20,000 gallons. It is heated by a fire beneath, and is terminated at the top by a cover, which gradually decreases in diameter, and at length joins the *worm*, in another vessel. Fig. 1 shows the present form of wash-still. If not agitated the thick particles of the wash would settle on the bottom of the still and cause it to burn. To prevent this the apparatus shown, called the "rouser," is introduced, and being revolved while distillation is going on the chains attached sweep the bottom of the still and keep its contents in motion. The wash is made to boil, and as alcohol boils and passes off in vapour at a temperature of 180° Fahr., while water requires a temperature of 212°, the heating is so managed as never to reach 212°, and the alcohol-vapour passes off with only a small portion of water-vapour. If the process were perfectly conducted no water would pass off with the spirit; but in practice there is always some, and to this extent the spirit is weakened by the mixture. The alcohol-vapour passes off into the worm, which is a copper tube curved spirally round the



inside of a vessel thirty feet high, called the worm-tub; the tube is two feet in diameter at the upper part of the vessel, and diminishes down to two inches near the bottom. The worm-tub is filled with constantly flowing cold water, which keeps the copper worm at such a low temperature that the vapour in the worm is condensed into a liquid. This liquid, forming the *low wines*, flows out of the narrow end of the worm into the low-wines receiver, from which it again flows into the spirit-still. Another distillation occurs, and sometimes a third, until so much of the water is driven off as to leave the spirit of a proper strength.

A great improvement in large distilleries is in the use of the "coffee" still. It is a large vertical still of considerable height, with an internal arrangement of alternate shelves. The liquor to be distilled is introduced at the top, and drops from shelf to shelf until it reaches the bottom; all the way down it encounters a current of steam, which is passed

in at the bottom. The process is continuous, and the separation is so complete that the spirit constantly passes off to the condenser from the top, and the waste liquor runs off at the bottom. Where the only object is to produce spirit for commercial purposes any substance containing starch may be used for the production of the wort. Potatoes are largely used for this purpose. The spirit is much contaminated with fusel oil or amylic alcohol, which must be separated. It has a high boiling-point, but is carried over by diffusion. The same impurity is found in raw-grain whisky, and gives rise to the unpleasant effects of that spirit.

Standard or "proof spirit" consists of one-half absolute or pure alcohol and one-half water: if a given bulk of distilled water weighs 13 ounces, an equal bulk of proof spirit will weigh exactly 12 ounces. This difference of specific gravity gives rise to the construction and use of the HYDROMETER. There are certain stages or degrees of strength, "above" or "below proof," according to circumstances; thus, the strongest spirit produced by distillation is 70° above proof, spirit of wine is not less than 43° above proof, raw spirits sold by the distiller to the rectifier are at 25° and 11° above proof, and gin is about 17° below proof. The rectifying, or giving a modified strength and a peculiar flavour to spirit, is effected in totally distinct establishments from those in which the spirit is produced from grain. Scotch and Irish *whisky* are distilled spirits, the flavour of which is derived from the malt having been dried by peat. English *gin* is flavoured with juniper berries, sugar, and other substances.

A large revenue is derived from distilled spirits, and the revenue officers exercise a most rigorous supervision over all the operations of a distillery.

Destructive distillation.—Many substances are distilled on the large scale in a dry state, as tar, petroleum and paraffin oils, benzole, and bisulphide of carbon, which are constantly purified and rectified by dry distillation. Other substances, when exposed in retorts to a red heat, are split up into other products, as in the destructive distillation of wood, where the products obtained are charcoal, acetic acid, and naphtha; peat, for charcoal, ammonia, and paraffin; coal and shale, which at a low temperature give coke, paraffin-oil, and ammonia, and at a high temperature, as in the manufacture of gas, coke, benzole oils, and ammonia. The splitting up of fats into fatty acids and glycerine by superheated steam is another large destructive distillation industry.

DISTOR'TION. This term comprises all permanent deviations from the natural shape or position of the body which are effected by the influence of external or internal force in parts originally soft and flexible, or such as have acquired unnatural pliancy by accident or disease.

1. Every part of the body capable of independent motion is furnished with two sets of muscles acting in contrary directions, the purpose of which is obviously to bring the part back to its place after movement in either direction. But if one set of the muscles should be suddenly cut across, the tension of their antagonists still remaining in action, the consequence would be a movement in obedience to the latter till the contraction had reached its limit; and the part in question would permanently retain the position into which it had thus been moved. The same effect would result if the muscle, instead of being divided, were paralyzed by the interruption of its nervous communication with the brain. Again, if the tone of one muscle were increased by spasm or otherwise, so as to give it a decided preponderance over its antagonist, the result would be similar. These considerations will sufficiently explain the nature of one large class of distortions, namely, those which result from affections of the *brain*, *muscles*, and *nerves*.

The simplest of these is the *drawn mouth* or *hemiplegia*, which arises from the muscles of the cheek on one side being paralyzed, and the retractors of the opposite angle of the mouth, no longer balanced by an equal force, drawing it up towards their origin, and retaining it in that position.

Strabismus, or squinting, is frequently produced in the same way by a partial paralysis of that muscle the office of which is to turn the globe of the eye in the opposite direction, or it may arise from undue contraction of the muscle on the same side.

Wry-neck is a distortion also due to irregular muscular action. It generally comes on gradually in infancy, and consists in a shortened and contracted state of the sterno-mastoid muscle of that side to which the head is inclined and from which the face is turned. *Club-foot* is often nothing more than a similar contraction of the muscles of the calf, which draw up the heel and eventually disturb the integrity of the ankle joint.

2. But by far the most common and important class of these affections is that which originates in disease of the bones. The firmness and rigidity of the bones depends upon the due proportion of the earthy matter, phosphate of lime, that enters into their composition. If the proportion of this ingredient be too great, as in old age, and in the disease called *fragilitas ossium*, they become brittle, and are broken by the slightest causes; if it be too small they become unnaturally pliant, and are distorted by the pressure of the superincumbent weight or the contraction of the muscles.

The latter condition is prevalent with other structural changes in the disorder called *rickets* (*rachitis*). This malady seldom appears within the ordinary period of lactation or after puberty. It is most common among the poor and in closely peopled districts, as all the diseases of children are; but it is by no means confined to either, or to children whose constitutions are apparently the most feeble in other respects. Indeed it is a frequent remark that the most robust and powerful men exhibit tokens of having been rickety in their childhood. Among such indications are smallness of the pelvis, with inward or outward curvature and disproportionate shortness of the lower limbs. This sudden check to the development of the skeleton, constantly observed in rickety children, with the distortion arising from the unnatural softness of the bones, is the most usual cause of the short stature of dwarfs.

Recovery, even from considerable degrees of this affection, is more frequent and rapid than might be imagined; but the pelvis and lower limbs, which, as above mentioned, are the most commonly and extensively implicated, seldom completely regain their natural proportions. This fact, as it regards the female pelvis, is worthy of notice, being the cause of by far the most dangerous kind of difficult parturition. It is in extreme cases of this sort that the Cæsarean operation has been practised.

Independently of rickety distortion, there are two other kinds of curvature of the spinal column which demand a brief notice. The first, which has frequently been mistaken for rachitis, is usually called *lateral curvature*, to distinguish it from the more serious kind of distortion next to be considerd, which is called *angular curvature*.

Unlike rickets, which almost always commences in infancy or early childhood, lateral curvature of the spine seldom appears before the tenth year. The external deformity consists in the prominence of one hip (generally the right), and elevation of the corresponding shoulder, the blade of which sticks out in an unsightly protuberance behind. The opposite hip and shoulder are respectively flattened and depressed, and the symmetry of the chest is destroyed, one side being larger than the other, and both twisted and misshapen. On examination the spine is found to have a double curvature sideways so as to resemble the letter S, but generally turned the other way, the concavity of the lower curve being on the right side and the upper on the left side. It arises from weakness in the spinal muscles and local elongations of the ligaments of

the vertebræ, from the habit of resting the weight in sitting or standing more on one side than the other, and that side is usually the right. The subjects of this kind of distortion are chiefly slender and delicate girls in the middle and upper classes, the poor being comparatively exempt. It is much promoted by means often used to prevent it, such as by confinement and restraint of the person and posture by stays, backboards, high-backed chairs, reclining on a board, and other contrivances to improve the figure and restrain the development of the natural form, as well as by the sedentary habits and inappropriate exercises of the academy or school-room.

Angular curvature of the spine is a deformity very different in its nature and appearance from the last described. It arises for the most part from ulceration of a scrofulous kind in the vertebræ. The support in front being thus lost by the decay of the bones, the spine is sharply bent forwards so that one or more of the spinous processes project behind, indicating the position of the diseased vertebræ.

Rheumatism and other disorders, and even common inflammations, occurring in a high degree within the joints or in their neighbourhood, occasionally produce like effects.

3. Distortions are sometimes occasioned by the contraction of other parts than those concerned in motion.

Such are those of the fingers and toes, which arise from chronic inflammation and permanent contraction of the aponeurosis, or fascia, a strong inelastic and fibrous membrane attached to the projecting points of bone, and stretched beneath the skin of the palm and sole for the protection of the nerves and other soft parts during the act of forcible grasping. The cicatrices left after a burn also produce various degrees of distortion.

A slight injury of the face below the eye, or the simple contraction from some other cause of the skin of that part, may produce the deformity called *ectropium*, or eversion of the lower lid; and the opposite state of inversion (*entropium* or *trichiasis*) may result from a similar contraction of the edge of the eyelid itself.

4. Another class of distortions may arise from external pressure, as of the bones and cartilages of the chest from tight stays, or of the phalanges of the toes from tight or ill-made shoes.

DISTRESS (*districtio*), in the jurisprudence of the middle ages, denotes legal compulsion generally. The modern distress, in its most simple form, is the taking of a man's movables in order to compel him to discharge some duty or make amends for some wrong.

Some rights, to which the law annexes the remedy by distress, have not been left to the protection afforded by the mere detention of the *distress*, by which term the thing taken is also designated; in certain cases a sale of the property taken by way of distress is allowed, if, after a certain interval, the party distrained upon refuses or is unable to discharge the duty or make amends for the wrong.

Distresses are made either for some duty omitted, or for some wrongful act done by the distrainee. Under the head of *distress for omissions* the most important among the feudal duties for which a distress may be taken is rent. Rent, in its original and still most usual form, is a payment agreed to be made by the tenant to his landlord for the occupation of land or a house. Such rent is denominated rent-service. To rent-service the law annexes the power of distress, without any agreement between the parties. By 4 Geo. II. c. 28, s. 5, the like remedy by distress is given in cases of rent-seck as in the case of rent reserved upon lease. See RENT.

There is also distress for damage done, which is called distress for damage-feasant. Cattle or dead chattels may be taken and detained in order to compel the payment of a reasonable sum of money for the injury sustained from such cattle or dead chattels being wrongfully upon property in the occupation of the party who takes them, and doing damage there. This is called a distress of things taken damage-feasant (doing damage).

The occupier of land may defend himself from damage by detaining the cattle which did the injury till compensation is made for the trespass. Not only the occupier of the land trespassed upon, but other persons entitled to share in the present use of the land, or of the produce, as commoners, &c., may distrain. In cases of distress for rent the party distraining must have the reversion.

If cattle trespass through the default of the occupier of the land, as by his neglecting to repair his fences or shut his gates against a road or a close in which the cattle lawfully were, such negligent occupier cannot distrain unless the owner of the cattle suffer them to remain on the land after notice and time given to him to remove them; and if cattle trespass on one day and go off before they are distrained, and are taken trespassing on the same land on another day, they can be detained only for the damage done upon the second day.

Cattle, if once off the land upon which they have trespassed, cannot be taken. The occupier must get satisfaction for the damage by action.

Things necessary for the carrying on of trade, as tools and utensils, or for tillage, as implements of husbandry, beasts of the plough, and sheep as requisite to manure the land, are privileged from distress while other sufficient distress can be found. But this rule does not extend to a distress for a toll or duty arising in respect of the thing taken as a distress, or of things connected with it; as a distress of two sheep for market-toll claimed in respect of the whole flock, or of the anchor of a ship for port-duty due in respect of such ship.

Things which a person has for the purpose of doing something to them in the way of his trade cannot be taken upon a distress on such person; as a horse standing in a smith's shop to be shod, or put up at an inn, or cloth sent to a tailor's shop to be made into clothes, or corn sent to a mill or market to be ground or sold. The goods of a guest at an inn are privileged from distress, as are also the goods of a lodger; but this exemption does not extend to the case of a chariot standing in the coach-house of a livery stable-keeper. Goods in the hands of a factor for sale are privileged from distress; and also goods consigned for sale, landed at a wharf, and placed at a wharfinger's warehouse.

Beasts of the plough may be distrained if no other distress can be found. Beasts of the plough may also be distrained upon where the only other sufficient distress consists of growing crops, which, though subject to distress, are not, as they cannot be sold until ripe, immediately available to the landlord. By 12 & 13 Vict. c. 92, it is provided that food and water shall be given to impounded cattle. By the Agricultural Holdings Act, 1883, cattle put out to feed can only be distrained upon for the amount paid for such feeding; and agricultural machinery, &c., not the property of a tenant, cannot be distrained.

A thing cannot be distrained while it is in use, as an axe with which a man is cutting wood, or a horse on which a man is riding. Implements in trade, as frames for knitting, weaving, &c., are privileged from distress while they are in use, otherwise they may be distrained upon if no other sufficient distress can be found. Fixtures are absolutely exempt from distress. Animals *feræ naturæ* cannot be distrained.

Rent is not due until the last moment of the day on which it is made payable. No distress therefore can be taken for it until the following day. A distress for rent or other duties or services can be taken only between sunrise and sunset, but cattle or goods found damage-feasant may be distrained at any time.

No distress can be taken for more than six years' arrears of rent; nor can any rent be claimed where non-payment has been acquiesced in for twenty years (3 & 4 Will. IV., c. 27). In the case of agricultural holdings distress can only be taken for one year's rent (Agricultural Holdings Act, 1883).

Under 8 Anne, c. 14, and 11 Geo. II., c. 19, where a lessee fraudulently or clandestinely carries off his goods in order to prevent a distress, the landlord may within five days afterwards distrain them as if they had still continued on the demised premises, provided they have not been (*bôna fide*) sold for a valuable consideration. And by the seventh section of the latter statute, where any goods fraudulently and clandestinely carried away by any tenant or lessee, or any person aiding therein, shall be put in any house or other place, locked up or otherwise secured, so as to prevent such goods from being distrained for rent, the landlord or his bailiff may, in the daytime, with the assistance of the constable or peace-officer (and in case of a dwelling-house, oath being first made of a reasonable ground to suspect that such goods are therein), break open and enter into such a house or place, and take such goods for the arrears of rent as he or they might have done if such goods had been put in an open field or place.

The landlord may enter a house to distrain if the outer door be open, although there be other sufficient goods out of the house. It is not lawful to break open doors or gates; but if the outer door be open, an inner door may be forced. If the landlord, having distrained, is forcibly expelled, he may break open outer doors or gates in order to retake the distress. If a window be open a distress within reach may be taken out at it.

A distress may be made either by the party himself or his agent. The authority given to the bailiff, as he is called, is usually in writing, and is then called a warrant of distress; but a verbal authority, or the subsequent adoption of the act by the party on whose behalf the distress is made, is sufficient. In order that the distrainee may know what is included in the distress, an inventory of the goods should be delivered, accompanied in the case of a distress for rent by a notice stating the object of the distress, and informing the tenant that, unless the rent and charges be paid within five days, the goods and chattels will be sold according to law. This notice is required by 2 Will. & Mary, sess. 1, c. 5, s. 2. By 11 Geo. II. c. 19, s. 10, goods distrained for any kind of rent may be impounded on any part of the tenant's ground, to remain there five days, at the expiration of which time they are to be sold, unless sooner replevied. After the lapse of a reasonable time the landlord is a trespasser if he retain the goods on the premises without the express assent of the tenant, which assent is generally given in writing.

The 2 Will. & Mary, sess. 1, c. 5, s. 3, directs that corn, grain, or hay distrained be not removed, to the damage of the owner, out of the place where the same shall be found or seized, but be kept there until replevied or sold; and 11 Geo. II. c. 19, which gives a distress for rent-service upon growing crops, directs, secs. 8 and 9, that they shall be cut, gathered, and laid up, when ripe, in the barn or other proper place on such premises, or if none, then in some other barn, &c., to be procured for that purpose, and as near as may be to the premises, giving notice within one week of the place where such crops are deposited; and if the tenant, his executors, &c., at any time before the crops distrained are ripe and cut, pay or tender the rent, costs, and charges, the goods distrained are to be restored. In all other cases, if the rent or other duty be paid or performed, or tendered to be paid or performed, before the distress is impounded, a subsequent detainer is unlawful, and a subsequent impounding or driving to the pound is a trespass.

The 14 & 15 Vict. c. 25, provides that growing crops if seized under a *fieri facias* shall, in default of other sufficient distress, be liable to rent which may accrue as long as such crops shall remain on the land.

The statutes which authorize the sale of distresses extend only to those made for rent; and nothing can be distrained which cannot be returned in as good a state as when taken.

A distress made by a party who has no right to distrain, or made for rent or other service which the party offers to pay or perform, or made in the public highway, or upon goods privileged from distress either absolutely or temporarily, is called a *wrongful distress*. Where no right to distrain exists, or where the rent or duty is tendered at the time of the distress, the owner of the goods may rescue them or take them forcibly out of the possession of the distrainor before they are impounded, but if impounded he cannot justify a breach of the pound to take them out; or bring either an action of replevin or trespass. In replevin, the cattle or goods taken are to be redelivered to the owner upon his giving security, by a replevin bond, for returning them to the distrainor in case a return shall be awarded by the court; and therefore in this action damages are recovered only for the intermediate detention and the costs of the replevin bond. In the action of trespass the plaintiff recovers damages to the full value of the goods; because, upon such recovery, the property in the goods is transferred to the defendant.

No action can be maintained for distraining for *too much rent*, unless the goods seized and sold are excessive with reference to the actual arrears.

An excessive distress is where the goods distrained are excessive in value and quantity, and an action for damages lies in such a case.

DISTRIBU'TION, a word of extensive importance both in political economy and physical science. As applied to the former, it comprehends the great social machinery by which the products of industry—the necessaries and luxuries of life—are diffused through the whole community. If the laws of distribution are not duly carried into operation, we must, with all our superabundance of national wealth, necessarily become, on the one part a class of unproductive idlers rolling in affluence, and on the other a race of degraded paupers—the two classes thus assimilating to the *patroni* and *clientes* of the Romans when the old republican virtues had become extinct. But in order to carry the laws of distribution into full effect, useful labour, profitably employed, is the great essential. Food, shelter, and raiment, which are all produced by industry, are the three first requisities. The natural wants of society, when in a healthy state, will aid in distributing the products of labour. The first object of industry is the cultivation of the soil, by which the food of man is supplied. The next is the erection of domiciles and the manufacture of household furniture, for protecting us from the inclemency of the seasons and securing our domestic comforts. The third object is the fabrication of raiment for clothing and decorating the person. When these wants are supplied the mind is gradually directed to those operations of labour which contribute to the ornaments, the enjoyments, and the luxuries of life, by which a nation usually arrives at greatness and a people becomes opulent.

The main element of this state of things is the spirit of commercial and manufacturing enterprise, which affords employment to myriads, and enables us to possess the surplus commodities of the most distant lands in exchange for the productions of our native industry. Every circumstance which tends to check this spirit circumscribes our means of employment to the industrious masses; and every undertaking, whether of a commercial, manufacturing, or national character, which contributes to social amelioration, is calculated to promote both useful and

ornamental labour, and thus is the means of distributing the productions of industry among every class of society; while, at the same time, it affords ample funds for the exigencies of the state, the support of our public institutions, and the due sustentation of the unfortunate, the aged, and the infirm.

Various adventitious circumstances may tend to arrest the progress or check the prosperity of commercial enterprise—such as war or civil anarchy, or great political revulsions—all of which are ever destructive to the arts of peace; although, without question, the most formidable of all checks to social prosperity is a deficiency or excessive dearness of food. Presuming, however, that food is abundant, of which, under the operations of free trade, we have the best guarantee, the next social difficulty is that of affording employment to all who are dependent on labour for their daily subsistence, and thus distributing the food and other necessaries of life through the whole community. This principle of distribution, through the agency of useful labour, is to the body politic like the heart's blood in the body physical. It is the vital stream of social life, which, like the arterial current of the animal economy, passes from the highest to the lowest members of the state, and, as it flows in its course, imparts vitality, health, and energy to all. To afford employment to the labouring classes in times of peace has been the great difficulty of all modern statesmen. Some of them appear like children picking pebbles on the sea-shore, who are pleased with the discovery of a few worthless toys, instead of taking an expansive view of the vast ocean of wealth which lies expanded before them. William Pitt recommended, as the great panacea for the want of employment, the army and navy, which, he stated, were always open to the working classes. But it must be evident that this advice can only be applicable in a time of war. The important difficulty is in affording employment to a great population during a period of peace, especially when steam and machinery, in almost all branches of manufacturing industry, can accomplish by the aid of one man what used to require a hundred.

It has been remarked by a popular lecturer on social economy that "the condition of the working classes is constantly deteriorating, and that the producers of wealth receive a very inadequate portion of the results of their industry." Some have ascribed popular distress to over-production; but until every man, woman, and child has an abundance of food and clothing, and proper housing, this explanation is fallacious. If distribution were effective over-production could not exist so long as multitudes were in want of those productions. In truth, the want of distribution, which is so lamentably defective all over Europe, may be looked upon as a kind of social disease which is calculated to disarrange and enfeeble every portion of the body politic. If the limbs and inferior members become diseased from want of circulation and nutriment the trunk itself must soon fall beneath its own weight.

Fortunately for the great interests of mankind a new order of things, resulting from freedom of commerce and cheap food, has been called into existence. Steam and machinery, which at one time menaced the destruction of nearly all physical labour, now accomplish more in affording the means of productive employment, and thus promoting the principles of distribution, than all the statesmen or political economists of modern times have ever devised. Machinery, railways, steam navigation, manufactures, freedom of commerce, great national and local improvements, and the spirit of social regeneration, are all calculated to call forth the industrial energies of the labouring masses; and by our freely exchanging the surplus products of native industry for those of the whole world we shall afford remunerative employment to myriads, and thus effectually carry out the great principles of distribution through every grade of society. But unless these principles are fully maintained and liberally fostered the free current of distribution will be arrested, and the mighty population of the British Empire, instead of constituting its glory and its strength, may become its weakness and its bane. The subject is further elaborated in the various writings of Mr. J. S. Mill, Professor Fawcett, and the several publications of the Cobden Club.

DITHYRAM'BUS, the name of a hymn in honour of Bacchus (the Dithyrambus or "twice-born," alluding to the god's second gestation in the thigh of Zeus), sung by a chorus of fifty men or boys as they danced round the blazing altar of the god; from this peculiarity it was also called the *cyclic* or *circling* chorus. The original subject of the song was the birth of Bacchus. No specimens of it have survived. From the dithyramb arose the GREEK DRAMA.

DIURET'ICS are agents which augment the urinary secretion and facilitate its expulsion from the bladder.

In attempting to ascertain or account for their mode of action we must constantly bear in mind the nature of the functions of the kidneys—viz. not only to remove from the body a considerable quantity of its fluid contents, but at the same time a great number of saline and other principles, the retention of which for any considerable time in the system causes serious departure from its healthy state, and in some instances speedy death. Not only therefore must the quantity of fluid eliminated be in due proportion, but the quality or chemical constitution of it must also be of a proper kind. The means which we employ to attain our object may be classified according to their primary modes of action on the system. Some are stimulant, such as gamboge, cytisus scoparius, alcohol, cantharides, spiritus ætheris nitrici, oil of juniper, oil of turpentine, &c. Some again are sedative, such as lactuca virosa, leontodon taraxacum, digitalis, squill, colchicum, &c. Others are refrigerant, of which some render the urine acid, such as the dilute mineral acids; some, on the opposite hand, render the urine alkaline, such as the carbonate of potassa, acetate, tartrate, and bitartrate of potassa; while certain saline diuretics do not render it either acid or alkaline, such as nitrate of potassa, bichlorate of soda, &c. When a very great quantity of fluid is present in the body some of it must be carried off by other means before diuretics can act, as the absorbents under such circumstances do not furnish a supply to the kidneys, the activity of absorption being always in an inverse ratio to the smallness of the quantity of the fluid present. If there be great general debility of the system, and particularly of the absorbents, this state must be obviated either by the exhibition of tonics previous to or along with the diuretic remedies.

DIUR'NAL MOTION, a term applied by astronomers and cosmographers to the daily revolution of the earth round its axis from west to east, by which all the apparent motions of the heavenly bodies can be accounted for. According to this now universally established theory the revolution of the whole celestial hemisphere from east to west is apparent only. During the period required by the earth to perform its diurnal revolution, the sun, moon, and stars may be roughly said (omitting their own proper motion) to appear to return in the course of twenty-four hours to the relative places they previously occupied. Although the stars differ in the extent of the path they apparently traverse, those at the poles having much the shortest arcs, and those which rise in the east the longest, yet every star is above the horizon for the same period of time. But these appearances are all clearly explained on astronomical principles when we admit the theory of the diurnal revolution of the earth, the motions of the heavenly bodies being only apparent to our senses, precisely as the banks of a river appear in motion to those who may be quietly seated in a steam-vessel.

Connected with the diurnal motion of the earth is the *diurnal change in the variation of the compass*, which has been the source of much speculation. If we commence our observations of the magnetic compass about seven o'clock in the morning, we shall perceive the needle to have a slight westerly motion, which continues till about two o'clock in the day. At this period its direction appears to change, the needle slightly retrogrades, and returns eastward until evening. It then takes a westerly direction, and returns during the night or early in the morning. Its maximum direction easterly is about seven in the morning. At some periods of the year, especially during the summer months, the daily change of variation amounts to 14′ or 15′. See DECLINATION.

DIVAN′ or **DIWAN′** is a Persian word familiar to readers of works relating to the East, where it is used to signify either a book of many leaves, a register of payments or account, a collection of poems or songs by one and the same author, or a senate or council. In this last sense it is most frequently met with in reference to the privy council or cabinet of the Sultan of Turkey. It may also refer to the low seats or cushions placed for the accommodation of guests, and in Western Europe is thus used sometimes in reference to a kind of sofa.

DIVE (River). See CALVADOS.

DIVERGENCY and **DIVERGENT.** See CONVERGENT.

DIVERS (Colymbidæ), a family of swimming birds (ANSERES), having a smooth, straight, compressed, and pointed bill. The Colymbidæ are expressly formed for aquatic habits. On the land they are awkward and embarrassed, shuffling along with their breast on the ground; but in the water they display amazing address and quickness, and they trust to their powers of diving for safety. It is not often that they can be forced to take wing, and they rise with difficulty; when, however, they have attained a due elevation in the air, they sweep along very rapidly, and are thus enabled to migrate or change their abode from the sea to inland lakes, or *vice versâ*. The wings are small, concave, and composed of stiff feathers; they are used as oars for giving additional impulse to the body when under water while the bird is escaping pursuit or giving chase to fishes. The limbs are placed as far back as possible; the tarsus is flattened laterally so as to cut the water, and the toes, either lobated or webbed, are so arranged as to fold up into a small compass when drawn towards the body in order to give the stroke. The plumage is deep, close, silky, and extremely glossy. The tail is short or wanting. The body is flat and oval, and from its depressed contour appears to float more deeply on the surface of the water than it does in reality.

The family Colymbidæ comprises two genera, the GREBES (Podiceps) and the true Divers (Colymbus).

In the genus Colymbus the bill is long, straight, and sharp-pointed; the feet are large; the three anterior toes are webbed, the hind toe is small and lobed; the tail is short, and concealed by the upper coverts.

In their aquatic habits and mode of life the true divers resemble the grebes, being more truly marine than the latter birds, who prefer lakes and fresh waters generally to the ocean. They seldom fly, unless for the purpose of migration. In swimming their broad flattened body is often immersed in the water, the head and neck only appearing above the surface. They dive without exertion, and can swim to a great distance before rising to breathe. The species of this genus are limited in number, and confined to the northern latitudes. They are migratory, passing in spring to the polar regions, where they breed among the fresh-water lakes of the interior, whence on the approach of winter they visit the coasts of more southern countries and those of our islands, feeding on herrings, sprats, and other fish. They lay but two eggs. The young differ greatly from the adults in plumage, and do not acquire maturity until after the third general moult. The divers are wild and cautious. Their voice is a loud wailing cry or scream.

The Great Northern Diver (*Colymbus glacialis*), the largest species of this genus, measuring nearly 3 feet in length, is met with chiefly in the arctic regions of both hemispheres, but advances further south at the approach of winter, when it occurs in great abundance about the shores of the northern parts of Scotland. At this period it lives principally on the sea, capturing herrings, sprats, and other small fish by diving; but in the summer these birds frequent the numerous fresh-water lakes of the extreme north, on the margins of which they make their large flat nests of dry herbage. On land the diver is very awkward, as it is compelled to rest upon its lower surface, and push itself on with its feet; but in the water it moves with surprising rapidity, its speed equalling that of a four-oared boat; and even under water it moves with undiminished swiftness, coming up at intervals for the sake of air, but often remaining below the surface for six or seven minutes at a time.

The Black-throated Diver (*Colymbus arcticus*) is common to Europe, Asia, and North America. The young, as well as adults, visit the Scottish friths and lakes, but are by no means abundant, though it is said that individuals occasionally remain during the summer, and probably breed on some of the lakes of the northern and western Highlands. This species is common in Hudson Bay, but, according to Richardson, is rarely seen upon the lakes in the interior.

The Red-throated Diver (*Colymbus septentrionalis*) is common to the arctic regions of Europe, Asia, and America; it is abundant on the coast of Hudson Bay, and upon the lakes of the interior, its haunts reaching even to the extremity of Melville Peninsula. The winter migrations of this species extend to the southern coast of England.

DIVES, a small town of France, in the department of Calvados, situated on the river Dives, 12 miles west of Pont l'Evêque, once a place of much importance, and still of great interest. The old church of Notre Dame has handsome carved doors, tablets with the names of the leaders who embarked with William, and other curious objects. There are also many interesting old houses, one of which was for some time the residence of Madame de Sevigné. On a hill to the north-east of the town there is a monument to William the Conqueror of recent erection, on the spot where he sat for many anxious days awaiting the arrival of the ships of his fleet at the appointed rendezvous. Population, 1001.

The river Dives rises in the high ground in the south part of the department, and has a northerly course of 60 miles to the English Channel. The harbour at its mouth, formerly large and safe, was the rendezvous of the fleet with which William the Conqueror invaded England, and the river was navigable 12 miles up; but it is no longer navigable, and the harbour is silted up to the extent of nearly a mile.

DIV′IDEND, in commerce, is a word which has two distinct meanings. In its more general employment it is understood to express the money which is divided, *pro rata*, among the creditors of a bankrupt trader out of the amount realized from his assets. See BANKRUPT.

Its other meaning is not so appropriate as that which has just been explained. It is used to signify the half-yearly payments of the perpetual and terminable annuities which constitute the public debt of this country. The payment of these so-called dividends is managed on the part of the government by the Bank of England, which receives a compensation from the public for the trouble and expense attending the duty. The periodical profits on shares in joint-stock companies, as railways, banks,

&c., are also called dividends. See BANK, BANKER, BANKING.

DIVIDEND, DIVISOR. See DIVISION.

DIVI-DIVI, the commercial name of the pod of the *Cæsalpinia coriaria*, a leguminous plant found in low marshy situations on the north coast of South America and in some parts of the West Indies. It has lately been introduced into Western India, and is found to thrive wonderfully in the Bombay Presidency. It is used for both dyeing and tanning, but chiefly for the latter purpose. The pod is from 2 to 3 inches in length and three-fourths of an inch in breadth, and when in perfection is of a rich brown colour. It contains a few small seeds, but the only valuable portion is a resinous matter of bright yellow colour, easily pulverized, which lies betwixt the outer skin and the husk that incloses the seed, and contains a large quantity of tannin. It is used by dyers, not only for the colouring principle which it contains, but for its strong astringent qualities as a mordant. In tanning it accelerates the process, and imparts to the leather a clean and healthy appearance. The quantity annually imported into the United Kingdom averages between 1000 and 1200 tons, valued at about £15 per ton.

DIVINA'TION is the general term for the pretended science of foreknowledge by means of oracles, dreams, omens, or ceremonies, such as those of the astrologer or augur; or the discovery of secret things in the same manner, or of hidden treasure by the DIVINING ROD, &c. All sorts of methods, in fact, have been used for divination. A book, frequently the Bible, is opened at random, and the contents of the page are held to unfold a prophecy. This method was so often applied to the works of the poet Virgil in the middle ages, he being held to have been gifted with necromantic art, and hence possibly to have bequeathed his power to his poems, that the practice came to be called *sortes Virgilianæ* (Virgilian lots). The pathetic jest of poor Falkland, who drew a sad "Virgilian lot" in playing with the old superstition at the time of the great Civil War of Charles I., is well known. The passage closely foretold his speedy death and the manner of it. Of the ancient forms of divination, such as auguries announced by the sight of birds to right or to left, or by their cries and mode of flight; of omens, told by the inspection of the mode in which the entrails lie folded within the slaughtered victim; of palmistry, where the folds of the hand serve the like purpose; of tripudiation, or the manner in which the sacred fowls fed, &c., the reader will find full and amusing details in such works as those of Tylor on "Primitive Culture," or on the "Early History of Mankind;" Lubbock's "Origin of Civilization;" Mayo's "Popular Superstitions," &c. Among the Jews, about whom, thanks to the Bible, we know more than about almost any other ancient nation, we find divination so universal as to have needed a special warning and severe punishment in the earliest times. (See Deuteronomy xviii. 9–12.) Elsewhere the other nations are spoken of as using it, as for instance the Babylonians in a striking passage in Ezekiel (xxi. 21), "For the King of Babylon stood at the parting of the way to use divination: he made his knives bright, he consulted with images, he looked in the liver" (entrails). Among civilized nations the practice is dying out, except as a pretty game (such as girls play, following Gretchen's example in "Faust," when pulling the daisy to pieces as they say, "he loves me—he loves me not"), but among savages it is in full force. Thus the New Zealanders plant a tree at a child's birth that the tree's growth may foreshadow that of the child; the Polynesians set up a row of sticks to represent the warriors absent in battle, and denote their fate by their steady posture or their fall. The Lapps have a curious mode of divination. They put a shoulder-blade in the fire, and then foretell the future by the arrangement of the cracks in the bone. This species of bone palmistry exists also among the Mongols, the native Siberians, and the Bedouin Arabs. And in remote rural parts of our own country we are startled by sometimes encountering the most complete faith in divination.

DIVINE RIGHT is the old idea of the tenure by which a king held his crown; he was the representative of the Deity, and as such was an entirely irresponsible monarch. The theory originated probably with the divine appointment of a king over the Israelitic nation, and the constant references to the sovereign as the "Lord's anointed." At the time of the trial and execution of Charles I. the question of divine right was hotly debated between Salmasius on the side of the king, and John Milton on that of the people. In some European countries the sovereign still claims to reign by divine right, and on the occasion of the coronation of the Russian czar in 1883 the principle was, as usual, asserted by the emperor placing the crown upon his own head. The late Comte de Chambord always claimed to be king of France by divine right.

DIVING is an operation formerly associated chiefly with the search for the "treasures of the deep," but in modern times the work of the diver has become better known in connection with many most useful and valuable engineering undertakings. The methods of diving, too, have vastly changed, the naked diver of ancient romance, gathering a long breath before he plunged for a few brief moments into the abysmal depths in search of coveted gems, having given place to a much less picturesque scene, in which a man of firm nerve and strong arm, by the aid of modern appliances, descends at leisure into the water and remains there busily engaged upon his task, not merely one or two minutes, but more than as many hours. The exploits of the Eastern pearl and sponge divers have been invested with a curious amount of extravagant exaggeration, many of them having been credited with the power of remaining under water from fifteen to twenty minutes at a stretch. Brought to the rude test of experiment, however, such endurance is found to be as purely fanciful as any Munchausen story. In a swimming and diving contest in a London swimming bath between some North American Indians and an Englishman, one of the Indians, a renowned diver, remained under water just one minute and a half, while a London artisan beat him by a few seconds. A man of very exceptional power of chest may possibly exceed this, but the limit of all human achievement of the kind may safely be placed well within five minutes.

Such being the case, it is evident that the carrying out of subaqueous operations on any considerable scale entirely depends upon artificial means to enable men to breathe freely and work beneath the water, and these modern ingenuity has supplied in the respective forms of the diving-bell, being a chamber closed at the top and sides and open at the bottom, in which one or more men can be lowered and moved about under water, and the diving-dress, worn by a single diver, so as to enable him to walk at the bottom. By whom these contrivances were first projected is unknown. The diving-bell was first brought into a practical shape by Halley, about the beginning of the eighteenth century. Its form was that of a truncated cone with the smaller end up, made of wooden staves like a barrel; it was ballasted with lead to make it sink and remain upright; it had in the top a strong glass window and a cock for the escape of foul air, and a supply of fresh air was lowered to it in barrels. The present form of diving-bell was introduced by Smeaton in 1779; it is oblong and rectangular, and was at first made of wood and afterwards of cast iron; it is supplied with air by means of a forcing-pump and flexible tube. Smeaton was also the first to apply the diving-bell to engineering purposes, such as the building of foundations under water, in the case of Ramsgate harbour, in 1788. The cast-iron diving-bell, as commonly used, measures about 6 feet by 4 horizontally, and

5 feet high, and is 2 inches thick in the top and upper part of the sides, increasing to 8½ inches or thereabouts at the lower edge, for the sake of stability. It usually weighs about 5 tons, and displaces 3½ tons of water, or thereabouts, when quite filled with air: the difference is the load on the crane and windlass by which it is lowered and raised. It has a number, not usually exceeding twelve, of bull's-eyes or glazed holes in the top to admit light; they are 8 or 10 inches in diameter, and the glass about 2 inches thick. The flexible feed-pipe for supplying compressed air is about 3 inches in diameter. If the quantity of air required be calculated according to the usual practice in public buildings it would amount to about 12 cubic feet, measured at atmospheric pressure, *per man per minute*. Signals may be made by persons in the bell to those at the pumps and crane by pulling cords and ringing bells, or by striking blows with a hammer on the inside of the diving-bell.

The diving-bell has of late years been to a great extent superseded by the *diving-dress*, which consists essentially of a metallic helmet, usually spherical, and made of copper,

Diver in Diving-dress.

inclosing the diver's head and resting on his shoulders, connected at its base with an air-tight dress. The helmet is fitted with a long flexible tube and valve, opening inwards, for supplying air from a compressing pump above water, an escape valve for foul air, opening outwards, about the level of the diver's chest, and some glazed openings (usually three in number) at the level of his eyes. Each of these openings should be furnished with a water-tight valve, which the diver can instantly close in the event of the glass being broken. The air feed-pipe enters at the back of the helmet, and the air is conducted thence by arched passages over the diver's head to points near the glazed eye-holes. By this arrangement the entrance of water is prevented in the event of the feed-pipe bursting. To overcome the buoyancy of the apparatus and enable the diver to sink, his waterproof dress is loaded with about a hundredweight of lead, part in the soles of the shoes, part fastened to the breast and back. He usually hauls himself up by means of a rope; but should he wish to ascend suddenly he has only to close the escape-valve, when the air inflates the waterproof dress and causes him to float to the surface. If necessary, he carries a bull's-eye lantern, air and water tight, and supplied with air in the same manner as the helmet. The above woodcut represents a diver in his diving-dress.

A process has been invented of breathing for hours under the water, without any of the ordinary appliances as to a supply of air. The invention is due to the skill and perseverance of Mr. Fleuss, who brought it into practical use in 1880. A special dress, with a helmet, is used; but the helmet is entirely closed, and there is no pipe to the air above the water, as is customary with ordinary divers. The feature of the invention is that a continuous supply of oxygen is procured from the helmet, where it is stored in a compressed state, the supply being regulated by a valve under the control of the diver. The original nitrogen in the lungs remains unaltered, and can be breathed over and over again with a due admixture of the oxygen. The carbonic acid which is exhaled is absorbed by caustic soda, contained in a small tin or ebonite case placed in the body of the dress. A proper arrangement of the tubing causes the whole of the exhaled gas to pass through this case, and the deadly carbonic acid is transformed into harmless carbonate of soda. The advantages of this apparatus are numerous, and there is no doubt that its use will not be confined to subaqueous work. It will, for example, enable the wearer to enter the densest smoke without any risk of suffocation, and will thus be a valuable addition at fire-escape stations. Its use for the rescue of unfortunate miners will also be possible. Its advantages in diving are mainly that the diver requires but one attendant, to whom he can signal if need be; the absence of an air-pipe relieves him of many anxieties as to his safety; he is free to move in any direction, and can creep under wreckage in a manner that the ordinary diver would consider hazardous, if not impossible.

The value of the Fleuss apparatus has been repeatedly tested—at the flooding of the Severn tunnel, for instance, when work with the ordinary diving-dress was impossible, owing to the great length of pipe the diver would have to drag after him into the cutting, into which it was necessary to penetrate in order to close an iron door 1020 feet from the shaft. This was safely accomplished by an operator on the Fleuss system. It has also been the means of saving many lives on the occasion of accidents in mines, as at the Killingworth Colliery in 1882. In fact, so manifest are its advantages that in 1883 the home secretary issued a circular strongly recommending owners of mines to provide themselves with the apparatus, or at any rate to combine for the purpose of having a supply in every mining district. A very useful addition by Mr. Fleuss is a limelight lamp, fed by a supply of oxygen at its base, which can be carried by the diver or fireman, and will give a brilliant light for many hours either under water or in the most polluted atmosphere.

DIVINING ROD, a forked branch, usually of hazel, by which it has been pretended that minerals and water may be discovered in the earth; the rod, if slowly carried along in suspension, dipping and pointing downward, it is affirmed, when brought over the spot where the concealed mine or spring is situated. The form, the material, and the mode of using the divining rod of the modern miners and water-finders seem to be superstitions of comparatively recent introduction. Many persons with some pretensions to science have been believers in the powers ascribed to the divining rod.

DIVINITY. See THEOLOGY.

DIVISIBIL'ITY OF NUMBERS. It is often a great advantage to know at once if a long number is divisible without remainder. The following rules may be of service:—

A number is divisible without remainder by 2 if it ends with an even number; by 4 if the two last figures are divisible by 4; by 8 if the three last figures are divisible by 8. Thus 165489872 is divisible by 2 because it ends with an even number; by 4 because 72 is 4×18; and by 8 because 872 is 8×109.

Any number is evenly divisible by 5 if its last digit is either 5 or 0, as 6825, 7310.

It is evenly divisible by 3 if the sum of all its digits is a multiple of 3, and by 9 if this sum is a multiple of 9. Thus 1359612 is divisible by 3 and by 9 because the sum of its digits is 27, a multiple of both 3 and 9; but 2675424 is only divisible by 3, since the sum of its digits is 30, which is no multiple of 9, although it is a multiple of 3.

It is evenly divisible by 6 if it ends with an even number and if the sum of its digits is a multiple of 3 (i.e. if it is divisible by 2 and then by 3), and by 12 if it stands the tests for 3 and 4 together. The number 3786534 fulfils all these conditions.

It is evenly divisible by 11 if when the sum of its digits added up alternately, beginning at the units place, and the sum of the alternate digits, beginning at the tens place, are added together, the combined sum be a multiple of 11. Thus, taking 15634256, we add 6, 2, 3, 5 together = 16, and to this we add 160, which is the sum of 50, 40, 60 and 10. Then $16 + 160 = 176$, which is 11×16. (See "Arithmetic," by Sonnenschein and Nesbitt, 1882.)

DIVISION is the arithmetical process by which we find out how many times one quantity is contained in another quantity. It may be symbolized by the expression of a fraction, as $\frac{3}{4}$ $\frac{a}{b}$; of a ratio, as $3 : 4$, $a : b$; or by the sign $\div$, as $3 \div 4$, $a \div b$. In each case it is meant to express 3 divided by 4, a divided by b; and in these cases 3 and a are the *dividends*, 4 and b are the *divisors*. The statement of how many times the divisor is contained in the dividend is called the *quotient*, and if there is a quantity left over beyond the whole number given by the quotient this is the *remainder*.

It has been acutely remarked (Sonnenschein, 1882) that division is only cumulative subtraction, just as multiplication is cumulative addition. If we want to divide 26 by 4 we need no table to tell us that with such a divisor and dividend the quotient will be 6 and remainder 2; for a child ignorant of tables can ascertain the answer by actually performing the work instead of stating the answer by cumulation. Thus:—

	26		14
(1.)	4	(4.)	4
	22		10
(2.)	4	(5.)	4
	18		6
(3.)	4	(6.)	4
	14		2

Here we see that we have actually taken 4 six times from 26, and we have 2 over. But in actual practice our course is to guess at the quotient, and then try our guess by multiplication. Suppose in $26 \div 4$ we guess the quotient to be 7, that is to say, we think $26 \div 4 = 7$. If we try it by multiplying 4 by 7 we find that $28 \div 4 = 7$, and not $26 \div 4$. Our guess was too large, and we soon discover that the quotient is 6. Of course what here applies to a quotient of a simple digit equally applies to one of tens, hundreds, thousands, &c.

Two varieties of division perhaps need remark:—1. To divide a (vulgar) fraction by a fraction, invert the divisor and multiply. Thus, $\frac{3}{4} \div \frac{1}{2} = \frac{3}{4} \times \frac{2}{1} = \frac{6}{4}$ or $\frac{3}{2}$ or $1\frac{1}{2}$. Here, in verbally stating the question, care is requisite. We do not desire to know the "half of three-quarters," for that would be three-eighths, and we should have multiplied the fractions: we desire to know "how many times one-half is contained in three-quarters," and we find that it is contained one and a half times.

2. To divide one number by another, subtract the logarithm of the divisor from that of the dividend. This we can readily prove. The logarithm of 4 is ·6020599, &c.; the logarithm of 5 is ·6989700, &c.; and the logarithm of 20 is 1·3010299, &c. Now, let the problem be to divide 20 by 5. We subtract the logarithm of 5 from that of 20.

1·3010299, &c.
·6989700, &c.

·6020599, &c.,

and we find on reference to the table of logarithms that the difference is the logarithm of 4, which therefore is the quotient. See LOGARITHMS.

DIVISION OF LABOUR, in political economy, is an important agent in increasing the productiveness of labour. The means by which it adds to the efficacy of labour are described by Adam Smith to be—(1) an "increase of dexterity in every particular workman;" (2) "the saving of the time which is commonly lost in passing from one species of work to another;" and (3) "the invention of a great number of machines which facilitate and abridge labour and enable one man to do the work of many:" to which may be added (4) the separation which it causes between labour and the direction of labour; (5) the power which it gives of using machinery effectually, when invented; (6) the opportunities of exchange which it affords, and the means of availing ourselves of the enjoyments arising from the natural capabilities of the soil, climate, situation, or mineral productions of different parts of the world, and of the peculiar aptitude of their inhabitants for various kinds of industry.

The power of distributing men into particular employments must be limited by the extent of the market in which the produce of their labour may be exchanged. When there are no means of exchanging men must provide everything for themselves that they require, and there is no further division of employments than that which necessarily takes place in families and in the most simple forms of industry. So, in every degree in which the situation and circumstances of men give facilities of exchange, do particular employments become assigned to individuals.

But while, by means of exchange, employments are thus subdivided, the labour of many men is most efficiently combined in producing particular results. The combinations of industry for one object are often truly wonderful, while the employments of those who are really co-operating with one another are so distinct that they are wholly unconscious of any combination at all, nor is their combination at once perceptible to others.

The effects of a combination of labour and division of employments upon the distribution of wealth is that, by multiplying the modes in which industry is made productive, it is the main cause of the various grades of society which exist in all civilized countries. The different employments of men determine their social position as labourers or employers of labour; and the wealth arising from the effect of the employment of labour is distributed through the several classes as rent, profits, and wages.

DIVORCE (from the Latin word *divortium*) is the legal separation of husband and wife. In England divorce was of two kinds—*a mensâ et thoro*, from bed and board; and *a vinculo matrimonii*, from the bond of marriage. In the year 1857 the law of divorce and matrimonial causes underwent some important changes. The old laws were almost entirely abrogated, and a Court of Probate and Divorce established, presided over by a judge ordinary, who has full authority to hear all matters arising therein, either by himself, or with one or more of the other judges. His salary is £5000 per annum.

Decrees of divorce *a mensâ et thoro* are now at an end. As the Act was first passed, petitions for the dissolution

of marriages were obliged to be heard by three judges at the least, but they can now be granted by the judge ordinary alone. Sentence of "judicial separation" (having the effect of the old divorce from bed and board) may now be obtained, either by the husband or the wife, on the ground of adultery, cruelty, or causeless desertion for two years and upwards. Applications for such separations may be made by either party by petition to the court, or to any judge of assize held in the locality where the parties reside or last resided, or to the court of quarter-sessions, or to the recorder of the city or borough in which the parties are or were last resident. The local authorities thus pointed out have full power to receive such applications and to decree a "judicial separation." They may also order alimony for the wife. An appeal, however, lies to the judge ordinary of the regular central court from the decrees of these local authorities; but no such appeal can stay the *interim* execution of the order for separation.

By the Matrimonial Causes Amendment Act, 1878, a magistrate may, if a husband be convicted of an aggravated assault on his wife, grant such an order as will have the full effect of a judicial separation on the ground of cruelty. The order may also provide for a weekly payment by the husband to the wife and for the custody of the children.

Wives deserted by their husbands may at any time apply to a police magistrate, or to the petty sessions, for an order to protect property earned by themselves, or of which they may have become possessed since the secession of their husbands, against their husbands or their husbands' creditors. Decrees of separation obtained during the absence of the husband or wife may be reversed on application and proof. Wives "judicially separated" are considered *femmes soles* as regards questions of property, and for purposes of contract and suing. According to the thirty-ninth clause of the rules and regulations of the court, applications on the part of a wife deserted by her husband may be made on summons to the judge ordinary in chambers—a course which saves the wife from exposing her case before a police magistrate.

An entire and absolute dissolution of the marriage may be presented to the Court of Divorce, on the ground that the wife has forfeited her conjugal rights by the crime of adultery, or that the husband has been guilty of adultery, combined with other violation of the marriage ties. Adulterers may be made co-respondents to petitions for divorce; and contested matters of fact may be tried, if the parties insist, by a jury. If the court of divorce be satisfied that there has been no collusion, condonation, or connivance, and that the charge of the petitioner is proved, the marriage will be absolutely and finally "dissolved." Alimony may be awarded to wives, even in the event of the marriage being thus dissolved.

Husbands may claim damages from adulterers if they please, and such claims will be heard and tried on the same principles, in the same manner, and subject to the same rules and regulations as actions for *crim. con.*, the damages being determinable by the verdict of a jury. Adulterers made co-respondents may be mulcted in the whole of the costs. The custody of children is provided for by interim orders of the Court of Divorce.

Questions of fact may be tried before the court by the verdict of a jury, special or common; and the court may direct issues to try matters of fact in any court of common law. All witnesses are sworn and examined orally in open court, where their attendance can be secured.

After the lapse of a given period, it is lawful for the parties divorced to marry again, as if the prior marriage had been dissolved by death; but no clergyman in holy orders, of the Church of England, is compelled to solemnize the marriage of any person whose former marriage may have been dissolved on the ground of his or her adultery.

Among other enactments, it is provided that a person may sue *in formâ pauperis*, on his making an affidavit that he or she is not worth £25 after the payment of all just debts.

Married women may dispose of their reversionary interest in personal property; but the Act does not enable married women to dispose of any interest in personal estates settled upon them, or agreed to be settled, on the occasion of their marriage.

In Scotland since the Reformation divorce *a vinculo matrimonii*, so that both parties may intermarry with others, has always been competent. It may be obtained at the suit of either spouse, on the ground either of adultery or wilful desertion for four years. Formerly actions of divorce proceeded before the commissary court, but since its abolition they are competent before the Court of Session only. The alleged paramour may be called as co-defender, and if the adultery is proved may be made liable in costs. In all cases the pursuer must make oath that the suit is not collusive, and in addition the lord advocate may intervene and lead such evidence of collusion as he deems proper. The trial proceeds before the lord ordinary without a jury, and an appeal lies to a division of the court, and to the House of Lords. Connivance of the husband in his wife's guilt is a good defence to the wife, but recrimination is not. As a rule condonation bars the action. Generally speaking the effect of divorce is that the party in fault loses all the benefits of the marriage, but the injured party is placed in the same position as if the other had died. Subsequent marriage is forbidden between the divorced adulterer or adulteress and the paramour. Judicial separation may be obtained on the same grounds as in England, but the action is competent to the Court of Session alone. Voluntary contracts of separation are not binding when either spouse chooses to return to cohabitation, but this will not bar a judicial separation if there are grounds for it. Aliment to wives driven away or deserted by their husbands may be awarded by the sheriff, but only for such short times as will enable the rights of parties to be put on a proper footing by application to the supreme court. A marriage may be declared null *ab initio* on the ground of impotency, but this is a procedure competent to the aggrieved spouse only. Husbands may claim damages for adultery as in England, independently of either divorce or separation. Claims of alimony and the custody of children are dealt with in Scotland much as in England, but such matters are competent to the supreme court only.

In the United States there is no national jurisdiction in divorce, and the matter is left to the legislatures of the different states and territories—each state determining for itself the causes for which divorce may be granted, and no general statement of the law can be made. In most states it appears to be allowed, not only for adultery, but for cruelty, wilful desertion, and habitual drunkenness. In New York divorce is allowed only for adultery; in South Carolina not for any cause; in some other states for causes to be determined by the court in the exercise of its discretion.

The Council of Trent, in 1562, issued a decree declaring marriage indissoluble even after the adultery of one or both of the parties; but the principles of the Reformation, then making progress in Europe, caused some change in regard to this rule. Roman Catholic countries adopted the principle laid down by the Council of Trent; and this rule continues to be in force in most countries in which that religion is paramount. By the Code Civil of France, however, divorce is allowable on the ground of adultery and certain other causes; but countries which adopted the reformed religion vary greatly in their practice.

From the conflict of the laws in various countries on the subject of divorce, questions have arisen as to the competency of a sentence of divorce pronounced with regard to a marriage solemnized in a country where such divorce would not be allowed. It appears now to be generally held that wherever the parties are living they will be

allowed to avail themselves of the laws of that country, provided the court is convinced the visit was not a temporary one merely for obtaining a divorce.

DNIE'PER, the *Borysthenes* of the Greeks, the *Danapris* of the Romans. From the swampy forest highlands on the confines of the Russian governments of Tver and Smolensk rise three great rivers, the Volga, the Dwina, and the Dnieper, which form the arteries of the internal navigation of Russia, carrying their waters respectively to the Caspian Sea, the Baltic Sea, and the Black Sea, and flowing throughout their whole course within the limits of the Russian Empire. Of these the Dnieper, rising in the circle of Viazma, in the northern part of Smolensk, flows south to the town of Smolensk, whence it turns west as far as Orsha, in the government of Mohilev; here it turns south, and running for several miles through that government it then reaches the boundary and divides Mohilev from Minsk. In this part of its course it is increased by many tributary streams, the chief of which are the Druts, the Soj, and the Beresina, which last is united to the Dwina by means of a canal. After forming the boundary between the governments of Minsk and Tchernigov, it enters that of Kiev, where it receives the Pripet (which the King's and Oginski canals connect with the Bog, the Vistula, and the Niemen), the Desna, the Teterev, and the Irpen. Soon after its junction with the Desna it forms the western limit of the government of Poltava, and turning to the south-east it enters that of Ekaterinoslav, having received in this part of its course the Psel, Vorskla, Orel, Sula, and other streams. Having passed the town of Ekaterinoslav, it runs south for about 60 miles, and in this part of its course forms thirteen rapids, which greatly impede the navigation of the river; below the rapids it flows south-west between the governments of Kherson and Taurida, and enters the Black Sea by a wide embouchure, through which also the Bog, the ancient *Hypanis* (which rises in the north-western portion of the province of Podolia), pours itself into the same sea. The embouchure is in fact rather a lake or gulf; it extends from Kherson to Otchakov, about 50 miles, with a breadth of from 1 mile to 6. It is for the most part shallow, and its shores are very unhealthy in summer, during which season salt is gathered from the dried-up swamps.

The entire length of the Dnieper, with its windings, is about 1000 miles; its average width is estimated at 700 paces. Its basin comprises fourteen of the finest provinces of Russia, with all of which it has communication by its navigable branches and by canals. The Dnieper flows for the most part between high banks, the greatest elevation of which is along the eastern side. The upper part of its course is through a marshy forest country, and in the middle and lower course it passes over many rocks. The river is navigable almost from its source to its mouth; even the obstructions presented by the cataracts have been removed by the magnificent hydraulic works of the Russian government; several of the ledges of the rocks having been entirely removed and channels formed, which are protected from winds by lofty dykes of granite. Produce is generally conveyed *down* the river to the cities on the Black Sea, but fleets of large barks also pass annually by the canals mentioned (and those that connect the Dwina with the Neva) to Riga and St. Petersburg. The freights consist chiefly of timber, corn, iron, linen, hemp, salt, &c. Below the cataracts upwards of seventy islands occur, which are full of serpents and wild cats.

As the Dnieper flows through more than nine degrees of latitude, there is great diversity of climate in various parts of its basin; at Smolensk the waters freeze in November, and continue ice-bound until April; at Kiev they are frozen from January to March only. The river abounds in sturgeon, carp, pike, and shad. There are bridges across it at Smolensk and Kiev; the one at the latter place, which is 1688 yards in length, and constructed with rafts, is removed about the end of October and replaced in the spring, as it would otherwise be destroyed on the breaking up of the ice.

The country between the Dnieper and the Bog was formerly inhabited by the Zaparog Cossacks. The designation *Za-parog* means "beyond the cataracts," and was applied to them from their position to the west of the cataracts of the Dnieper. These hordes were dispersed in 1768, but the name Zaparog is still applied to the inhabitants of this region.

DNIES'TER, the ancient *Tyras*, a river of European Russia, rises in a small lake on the north-eastern slope of the Carpathian Mountains, in Austrian Galicia. In Galicia it flows south-east past Sambor and Halicz, and receives the Stryi, Swica, Lomnica, and Bistritza on its right, and the Zlota-Lipa, Stripa, and Sered on its left bank. On reaching the northern boundary of Russian Bessarabia, where it receives the Podhorze or Zbruck, it runs eastwards to Ushitza, but soon afterwards flows again towards the south-east, separating Bessarabia from Podolia and Kherson, and enters a marshy lake about 19 miles long and 5 broad, but not more than 7 feet deep, which lies between Akerman and Ovidiopol, and communicates with the Black Sea by the Otchakov and Tsaregrad passes, which are separated by a long series of low sandy islands. The current of the Dniester is exceedingly rapid. The navigation commences at Halicz, but is interrupted below Yampol by two considerable falls and several whirlpools, and it does not become free again until it reaches Bender. As far as Old Sambor it flows through a deep broad valley, which afterwards expands on its eastern bank into an extensive plain, while on its right bank it is occasionally skirted by offsets from the Carpathian chain. Below Khotim it flows through an open flat country. Its whole course is about 600 miles long, and the average breadth is said to be 170 yards.

Timber, grain, and other products are conveyed down the Dniester to Odessa. The river abounds in sturgeon.

DOAB', a word signifying *two waters*, which is used in Hindustan to denote any tract of land included between two rivers. There are several Doabs in Hindustan, but the district to which the name is most generally applied is situated between the Ganges and the Jumna. The prevailing character of the Doab is flatness and nakedness. The principal productions are millet and barley, sugar, cotton, tobacco, and indigo.

DOBRUD'SCHA or **DOBRUDJA**, that portion of the province of Bulgaria which lies north of Trajan's Wall —that is, of a line joining Rassova to Kustendji. It consists of low grassy hills, composed of eruptive rocks, younger granitic greenstone, porphyry, &c., and is bordered by Tertiary and Aralo-Caspian strata and the marsh lands of the delta. The principal places are Rassova, Hirsova, Matchin, Isakdje and Tultcha, Babadagh, and Kustendji. The Dobrudscha has been the constant scene of warlike operations. It was formerly known as *Scythia Minor*.

DOCK, a place artificially formed for the reception of ships, the entrance of which is generally closed by gates. There are two kinds of docks, dry or graving docks and wet docks. The former are used for receiving ships in order to their being inspected and repaired. For this purpose the dock is so contrived that the water may be admitted or excluded at pleasure, so that a vessel can be floated in when the tide is high, and the water run out with the fall of the tide, or be pumped out, the closing of the gates preventing its return. Wet docks are formed for the purpose of keeping vessels always afloat, so that the operations of loading and unloading can be performed without being interfered with by the variations of the water level. Dockyards belonging to the government usually consist of dry docks for repairing ships, and of

slips on which new vessels are built; besides which they comprise various workshops and storehouses.

The first wet dock for commercial purposes made in this kingdom was formed in the year 1708 at Liverpool. Since that time others have been added at different periods; and at present the margin of the Mersey along the whole extent of the town, for nearly six miles, is occupied by docks. At Birkenhead, opposite Liverpool, fine and extensive docks have also been built.

The first commercial wet dock constructed in the port of London was for the accommodation of vessels employed in the Greenland whale fishery. This dock, which is now known as the Commercial Dock, is situated at Rotherhithe; it occupies altogether 49 acres, about four-fifths of which are water; it is now used mainly for the timber and corn trade.

Up to the end of the last century nearly all ships arriving in London discharged their cargoes into lighters in the river. To remedy this inconvenience a plan was sanctioned in 1799 for constructing wet docks for the reception of ships employed in the West India trade at the Isle of Dogs, now known as the West India Docks. The London Docks, situated at Wapping, were finished in 1805. The East India Docks, constructed for the reception of ships employed by the East India Company, are situated at Blackwall, below the entrance to the West India Docks. The St. Katherine's Docks, situated between the London Docks and the Tower, were opened in 1828; the Victoria Docks, near the Plaistow marshes, in 1855, and the Millwall in 1868. In 1865 an amalgamation was effected between the London, St. Katherine, and Victoria Dock Companies, and under the new management such enlargements were effected as rendered the Victoria Docks the largest and most commodious in the kingdom. The new extensions were opened in June, 1880. Wet docks are generally entered by means of what is called a lock, the gates of which are usually opened and shut by chains, worked either by winches or capstans. Formerly the labour was generally performed by hand, but of late years hydraulic machinery has been used for that purpose in many cases. Great care has to be taken to prevent the "silting" by deposits of fine mud, caused by the admission of a considerable body of turbid water by the gates, and dredging or some other plan has often to be resorted to in order to keep the dock clear.

Tidal Docks are merely basins surrounded by quay walls, and having open entrances they possess the advantage of requiring no opening or shutting of gates. They answer very well in places where the tides are small, but where they are of considerable range they have the disadvantage of large vessels grounding at low water, and from the large volume of water, more or less turbid, which enters at every tide, they are much more liable to silt up than wet docks. The docks are maintained by dues or rates levied on the tonnage of vessels using them, and for accommodation in the vaults and warehouses rent is charged according to the nature or value of the goods and the length of time they remain. There are government docks at Portsmouth, Plymouth, Chatham, Pembroke, &c. Figs. 1, 2, and 3, Plate I., show sections of the quay wall of Prince's Dock, Liverpool; fig. 4, a similar section from the London docks; fig. 5, a portion of the parade wall next the Mersey at Liverpool; fig. 6, a section of a quay wall with extended base; and figs. 7 and 8, the entrance lock and chamber of Prince's Dock, Liverpool, in transverse section.

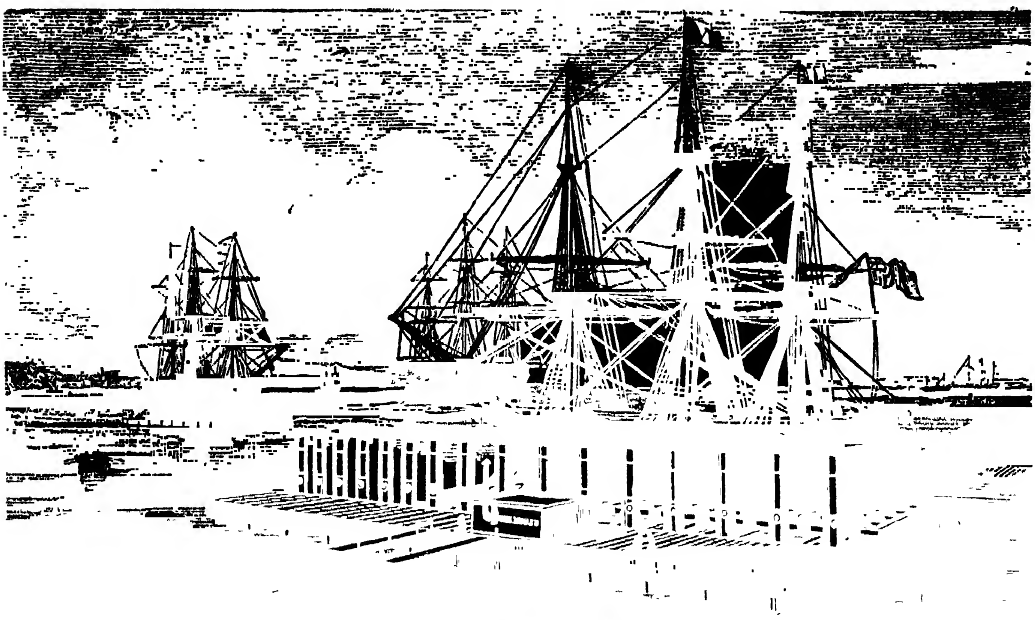
Graving Docks.—One of the most efficient and economically built graving docks is situated at Birkenhead. Fig. 8, in Plate II., explains its form and size. It is constructed entirely of concrete, with the exception of the granite coping around its upper part, and it was completed in about two years from its commencement at a cost below £120,000. The ground below it is sand and clay, retained by a line of "sheet piling" of Baltic pine, driven to the depth of about 20 feet; a bed of puddled clay receives the concrete dock-bottom, which is 4 feet thick; the dock sides are formed of concrete blocks; it is otherwise completed as shown in figs. 9 and 10. It will be observed in the plan that the steps at the head of the dock are arranged with a curved ascent, instead of having the same means of access as that provided at intervals along the sides of the dock, the latter arrangement being preferable; but the narrow space of ground available at the head of the dock led to the deviation being made as described. The dock is furnished with two pumps of 50 horse-power each, one of which is found to be sufficient, and 14 feet depth of water can be pumped out in about one hour and a half. The pumping machinery serves three docks at one time if necessary, as their drains lead into one well. The gates are opened and closed by ordinary capstans with manual labour, a service now usually replaced elsewhere by steam or hydraulic power.

There are now few harbours of importance which do not possess facilities for effecting repairs, &c., to the bottoms of vessels, either by graving docks, patent slipways, floating docks, or pontoons. Recently a list with details of the dry dock, slipway, and crane accommodation throughout the world has been published in the appendix to "Lloyd's Register Book."

The patent slip has its advantages over both the shore and the floating dry dock, where the nature of the land or the capacity of the water-space would either be unsuitable or otherwise entail excessive cost. In some shipbuilding yards, where the shore-frontage is very narrow, the patent slip admits of several vessels being built in the rear of wharves or warehouses, but abreast of the upper part of the slip, on to which, when ready, they are drawn sideways, and afterwards lowered to the water on the slip-cradle; in a similar manner vessels are drawn up, moved aside for repairs or lengthening, while the slipway itself is left available for work which may require a less time to complete. The slipway recently constructed at Ayr is an excellent work of its kind; it is capable of hauling up vessels weighing 1200 tons dead weight; its length is 850 feet, with a gradient of 1 in 24: the slipways are made of concrete, with strong chilled cast-iron rails on the top bedded in cement and causewayed between; at the lower end of the slipways there is a depth of water at ordinary high tide of 22 feet. The hauling machinery is simple, a steel wire-rope being used instead of the ordinary long detaching links of chain bars; the wire-rope is 4 inches in diameter, and is wound upon a drum 10 feet long and 9 feet 2 inches in diameter; the "outhaul" is a 1½-inch chain. The power is derived from two boilers, 18 feet × 5½ feet; the engines have two cylinders of 15 inches diameter, with 2 feet 6 inches stroke, and a speed of from sixty to ninety strokes per minute. After a vessel has been placed on the cradle it is pulled up, without stoppage, at the rate of from 12 to 18 feet per minute. The whole time occupied, from placing the vessel till it reaches the head of the slip, seldom exceeds twenty-five minutes; so that a vessel can, if necessary, be put afloat again on the same tide. The older method of using direct hydraulic power requires a stoppage for each stroke of the press, and the removal of its corresponding length of chain bar, thereby expending a much greater amount of time. Fig. 11, Plate II., shows the elevation of the hauling engine; fig. 12 is a ground-plan showing the winding drum, engines, and boilers; fig. 13 shows the rails, &c., for the slip carriage.

Floating Docks.—All ship, and steamers more than sailing vessels, require frequent overhauling to cleanse the bottom from weeds, marine animals, shells, ooze, and mud, and to effect repairs of various kinds which it is almost

impossible to do when the ship is floating in deep water. Formerly the dangerous process of careening was sometimes adopted—that is, the ship was tilted to a considerable angle in order to expose one side of the bottom. But there was the peril of over-tilting, and indeed it was owing to this that the *Royal George* was upset and sunk at Portsmouth in 1782, with 900 persons on board. Another mode was by beaching, or running the vessel on any convenient beach at high water, and effecting the repairs after the tide had receded. This plan, however, is not applicable to many of the large vessels now in use, as the localities are very few where the rise and fall of the tide are sufficient for the purpose of leaving the whole of the hull dry at low water. Of course, the best plan of obviating all difficulty is the construction of a dry dock on the principle described under *Graving Docks*, with gates and pumping apparatus to maintain the interior dry; but in many parts of the world the nature of the coast and other circumstances preclude the formation of such a dock. To meet this difficulty floating docks have been devised. The principle which governs these gigantic structures is a power of changing at pleasure the buoyancy or level of flotation, determining whether a vessel shall sink deeply in the water or float high upon the surface. The illustrations of a floating dock built for the Spanish government, and now in use at Ferrol, which will be found in Plate III., give a good idea of the shape of all floating docks. They are built cellular throughout—sides, bottoms, and ends. The sides are double, and the space is divided off into numerous compartments, water-tight and nearly air-tight, by vertical and horizontal partitions. Some of these compartments are called load, some balance, and some air chambers; and by a skilful management of them the huge fabric may be raised and lowered at pleasure. For instance, supposing a large vessel to be in need of repair, and ready to be docked in some harbour provided with a floating dock, the load chambers are pumped full of water by steam-pumps fitted for the purpose, by which means the dock is sunk below the level of the horizontal partitions which divide the balance and air chambers. Water sufficient to sink the structure low



Clarke's Hydraulic Lift.

enough to admit the entering of the vessel is forced into the balance chambers by means of valves in the outer side of the dock, and when the vessel has floated in the water is cleared from the vast interior of the dock by the united agency of pumps, valves, and sluices. The dock rises, and the vessel with it—the latter resting quietly on the floor of the former; and any repairs which the ship or its machinery may require are then conveniently attended to, as the workmen can reach the very keel itself without encountering a single drop of water. When all the repairs are finished, the operations of the pumps, sluices, &c., are reversed, and the ship emerges in deep water. Formerly great expense was incurred in the construction of floating docks, in consequence of their having to be first built up in this country—fastening all the parts together by means of screw-bolts, and putting on each individual piece a mark indicative of its special position—and pulled down again and re-erected abroad, so that the whole work had to be done twice over. This has been obviated by the plan of reducing the number of shapes of the plates employed to a little over 400, and these are all shaped in such a manner that by means of an explanatory drawing the dock can be erected abroad with great ease and rapidity, and of course at a much less cost. Floating docks constructed on this principle have in practice proved thoroughly successful.

Clarke's Hydraulic Lift, which somewhat answers the purpose of a floating dock, is situated at the east end of the south shore of the Victoria Docks in the river Thames. It consists of an excavated channel of about 300 feet long and about 60 feet broad, on each side of which sixteen cast-iron columns, 5 feet in diameter, are sunk 12 feet in the ground, 20 feet from centre to centre. At the bottom of the column there is a hydraulic press, or rather lift. The diameter of the ram is 10 inches, with a travel of about 25 feet. On the top of the piston or ram a wrought-iron crosshead is fitted, from which iron links are suspended and connected with a cast-iron girder, one on each side of the column; so that there are sixteen coupled girders of about 60 feet long and 20 feet apart, each couple being suspended and lifted by two hydraulic rams or pumps.

On the top of these girders a pontoon is placed of the requisite length. These pontoons vary from 150 to 320 feet in length, and are 50 feet broad. The smaller are placed on eight sets of coupled girders, and the larger on the whole sixteen. They are made of sufficient depth for stiffness and in order to give the required displacement, so that when empty they have buoyancy enough to keep the vessel well out of the water. The pistons or rams are worked by a pair of horizontal engines. These engines are on the expansive condensing principle, with one high-pressure cylinder of 23 inches diameter and 2 feet stroke, and two expansion cylinders of 32½ inches diameter with the same stroke. The steam expands from the small cylinder into the two larger ones; the pressure of steam per square inch is 50 lbs., and the indicated horse-power 120. The engines work twelve hydraulic force pumps of 1·96 inch diameter and 2 feet stroke in three groups—viz. two groups of three and one of six pumps. The amount of pressure obtained is 28 cwts. per circular inch, equal to about 4000 lbs. per square inch. From these pumps the water is discharged through wrought-iron pipes half-inch internal diameter and one inch external, and above 10,000 feet in length. The following is the manner of docking a vessel:—The girders with the pontoon upon them are allowed to sink to the depth required for the particular vessel to be docked. She is then hauled over the pontoon and on to the blocks, and shored or rather wedged up by movable bilge blocks instead of breast shores. The pontoon and vessel are lifted out of the water, and the water in the pontoon allowed to escape by valves. When empty the valves are closed, the girders lowered, and the pontoon left to bear the whole weight of the vessel, and to be moved into any suitable position. To give greater accommodation Mr. Clarke arranged a system of shallow docks eight in number, communicating with a shallow basin of about 500 feet square, into one of which the pontoon has to be floated. The space occupied by the docks and basin is about 25 acres. Vessels of 1800 tons burden can be easily lifted and repaired. Still larger lifts, designed by the same gentleman, are now in operation at Malta and Bombay—vessels of over 3000 tons being raised out of the water at the former place, and by means of pontoons the lift is able to do the work of ten docks.

The Depositing Dock constructed by Messrs. Clark & Standfield at Barrow-in-Furness is intended to accommodate vessels of nearly 3200 tons displacement, not only raising them out of the water, but placing them on fixed staging erected along the shore. It is constructed so that it may be taken into two equal parts, each provided with its own engine, pumps, &c.; each half will thus form an independent dock for smaller vessels, and will also be able to raise the other half so that every part of the dock can be readily got at for cleaning and painting.

On referring to Plate IV., figs. 18 and 19, it will be seen that the dock consists of a rectangular box-side, to which are attached pontoons, forming the bottom of the dock. To the side also an outrigger is attached by means of a parallel motion which allows it always to float, whatever may be the position of the dock itself. The chief function of this outrigger is to preserve the horizontality of the dock during the operations of raising and lowering the vessel. It forms, at the same time, a very convenient working platform and store for spare blocking, tools, &c., as it is connected with the pontoons by means of four gangways passing through the side of the dock, and by two others on the outrigger guides round the ends of the dock, as shown in plan (the outrigger guides have been omitted from the end elevations for the sake of clearness). There are also two large and convenient ladders for communication between the outrigger and the upper deck of the dock.

When the dock has been lowered by allowing water to enter the pontoons in the usual manner, the vessel is brought over the keel blocks, as shown in fig. 18, and is centred by means of travelling side shores, which are placed a little above the water line; having secured the vessel by a couple of hawsers, water is pumped out of the pontoons, causing the dock to rise, and allowing the vessel to bear on the keel blocks. The bilge blocks are then drawn in by means of chains worked from the upper deck, and pumping is proceeded with until the vessel is quite clear of the water, as shown in fig. 21.

Its specialty, however, from which it derives its name, consists in its being able to deposit any number of vessels high and dry on fixed staging erected along the slope of a wet dock or shore. The staging is constructed of parallel piers of ordinary pilework, as shown in fig. 20; these piers are about 5 feet broad and about 15 feet apart.

To deposit a vessel the dock is brought up to the staging, and the pontoons with the vessel on them are entered between the piers. When the vessel has been brought over the keel blocks on to the staging, the dock is slightly lowered to allow of the vessel taking a bearing on them; the bilge blocks are then adjusted, and the dock is lowered quite clear of the vessel; it is then withdrawn, and is ready to accommodate another vessel. The vessel has thus, without any sliding or rolling motion whatever, been deposited on the staging, as shown in fig. 20. This view shows also on one side a light floating crane and painting stage provided with adjustable platforms; this stage is of convenient size to enter either between the pontoons of the dock or between the piers of the staging, as may be required. On the other side is shown a similar light crane and stage running on broad gauge rails. By means of these floating and portable stages both sides of the vessel may be reached and painted with the greatest facility; the railway may be continued the whole length of the staging, which at Barrow will, to commence with, be made long enough for the accommodation of four vessels.

In Plate IV., fig. 21 is a side elevation, and fig. 19 a plan which shows a vessel on the dock ready to be shifted to the fixed staging. Fig. 20 shows the ship deposited on the fixed platform, and indicates the arrangement of painting stages, &c.

There are twelve or more pontoons, each of which is divided into four water-tight compartments by three transverse bulkheads—namely, one central bulkhead directly under the keel of the vessel, and one intermediate bulkhead on each side of the central one.

The side of the dock is divided into water-tight compartments; the bottom of the uppermost one is formed by an intermediate water-tight iron deck placed about 12 feet below the upper deck. The engines and machinery are placed on this deck so as to leave the upper deck perfectly free for the working of the dock.

The outrigger is also divided into water-tight compartments; both the side and the outrigger are stiffened by bulkheads and angle-iron frames. This dock has the important peculiarity that, by the insertion of a central section, it can at any time be readily extended in length and increased in power so as to dock and deposit vessels of 5000 tons or even 6000 tons displacement.

DOCK, in botany. See RUMEX.

DOCK WARRANT is an acknowledgment on the part of the dock company that they hold and are responsible for certain quantities of goods specified therein. It is transmissible by endorsement, and the goods are deliverable to the last holder, unless delivery has been previously restrained by means of a judicial injunction. It will be thus seen that these warrants have the qualities of securities, for they represent the goods themselves. Most careful rules are of course laid down by the principal dock companies as to obtaining warrants. In case a warrant is lost a new one is never issued; but the owner of the

goods, on producing proof of his right to them, can obtain delivery on advertising the loss of the warrant in one or more of the daily papers, and giving indemnity, with a joint security to the dock company, against any future claim.

DOCKYARD, a naval arsenal for the construction, repair, and equipment of ships—embracing, generally, building slips, repairing docks and basins, workshops, and all the machinery and tools necessary for the manufacture of anchors, cables, and other adjuncts of a ship, and storehouses. The royal dockyards of Great Britain are those of Portsmouth, Plymouth, Chatham, Sheerness, and Pembroke. Woolwich Dockyard, one of the most complete establishments of the kind, was closed in 1869, having become unsuitable in consequence of the increasing depth of ships of war, and the difficulty of navigating them so high up the Thames. For the same reason Deptford Dockyard was also closed in 1869, but a portion is retained as a naval victualling yard.

DOCTOR, one who has taken the highest degree in the faculties of divinity, law, medicine, literature, science, or music (D.D., LL.D., M.D., D.Lit., D.Sc., and Mus. Doc.) In its original import it means a person so skilled in his particular art or science as to be qualified to teach it. In these, as in all faculties, the lower degree is that of Bachelor, B.D., LL.B., M.B., B.Sc., Mus. Bac., as it is with B.A., B.S. But in the last named (Arts and Surgery) the highest degree is that of Master, not Doctor—namely, M.A. and M.S. respectively. The reason of the difference is not clear. The title of doctor as an academic distinction first came into use about the middle of the twelfth century, which was the period of the first dawning of literature after its extinction in the dark ages. At all the universities where the title of doctor is granted there are certain examinations and periods of probation to go through, though the Archbishop of Canterbury claims a long-established right to create doctors at his will. This right is now rarely exercised except to make bishops D.D. or cathedral organists Mus. Doc. Thus to obtain the distinction of Doctor of Laws in the University of Cambridge, the candidate must have previously been five years a Bachelor of Laws, or seven years a Master of Arts; but to obtain the title of Doctor of Divinity the candidate must have been seven years a bachelor of that faculty. To obtain the title of Doctor of Medicine the same terms are required as those for the faculty of law. The same periods of probation, with some slight variations, are required at Oxford and Dublin. No clergyman can be appointed a bishop until he has taken a doctor's degree; neither can any medical student practise as a physician until he has graduated as a Doctor of Medicine; nor any civilian plead as an advocate in the ecclesiastical courts without the diploma of Doctor of Laws; but since the enactment of the new laws of divorce and probate, the privileges of the legal doctors have sunk into comparative nullity. A distinction should be drawn between the LL.D. (Doctor of Laws) of London, obtainable only by a severe series of examinations, and the D.C.L. (Doctor of Civil Law) of Oxford and LL.D. of Cambridge, which are now chiefly mere marks of honour. The first is increasingly a mark aimed at by men who seek the highest rewards of their profession, and pursue it with real love for it rather than as a means of living; the second is bestowed upon poets and soldiers, upon men remarkable for statecraft, and upon those remarkable for wealth, with a rather indiscriminating hand, by the Universities of Oxford and Cambridge.

DOCTOR, a fish. See ACANTHURUS.

DOCTORS' COMMONS, the College of Civilians in London, near St. Paul's Churchyard, founded by Dr. Harvey, dean of the Arches, for the professors of the civil law. It was burnt down in the great fire of London, and rebuilt at the charge of the profession. This ancient college, once the great seat of civil and ecclesiastical law, was shorn of its importance by the establishment of courts for the trial of divorce and matrimonial causes, and courts of probate, in 1858. The office for the registry of wills remained for some time afterwards at Doctors' Commons, but was in 1875 transferred to Somerset House, whither the vast accumulation of wills was removed.

DOD'DER (Cuscuta) is a genus of plants met with in most temperate climates, the species fixing themselves on the branches of woody or other plants, twisting round them, striking a number of minute suckers into their bark, and thus attracting from the system of the plants and from the air the sustenance necessary to their own support; hence they are true parasites.

The Common Dodder (*Cuscuta europæa*) is a white or reddish-looking annual, which flings its threadlike arms like a cluster of living threads round the branches of heath, furze, &c., on commons and dry wastes. It has no leaves, except tiny scales that stand in their room; and it bears small clusters of white bell-shaped blossoms. The germination of the dodder is effected, like that of plants in general, in the earth, and without requiring the presence of other vegetables.

The dodders are very dangerous to fields of flax and to leguminous plants, which they attack, and upon which they multiply themselves with singular rapidity. The dodder seed should be sifted from the flax or other seed. Cuscuta belongs to the order CONVOLVULACEÆ. The seed has a spiral threadlike embryo, without cotyledons.

DODD'RIDGE, PHILIP, D.D. (born in London in 1702, died in 1751), a dissenting divine who, on account of his singularly amiable disposition and manners, his ministerial assiduity, piety, and learning, is regarded as one of the ornaments of the religious community to which he belonged. It was early perceived that the turn of Doddridge's mind peculiarly pointed to the profession of a minister, and he was entered at a dissenting academy over which Mr. John Jennings presided, at the village of Kibworth, in Leicestershire, in 1718 or 1719, and in 1722 commenced his ministry at Kibworth. Several years passed, during which Doddridge led the life of a nonconformist minister, his services being divided between the people who attended the chapel at Kibworth and the congregation at the neighbouring town of Market Harborough. He was diligent in his ministry, but he found time for much theological reading. In 1729 he began his academy, which soon attained a high reputation. It was the institution in which most of the more distinguished ministers of the old dissenters in the middle of the eighteenth century were educated. It was first established at Market Harborough, where he at the time resided; but before the end of the year he removed to Northampton, having been invited to become the minister of the dissenting congregation in that town; and at Northampton he continued, both as pastor of the dissenting congregation and head of the dissenting academy, till his death. He died at Lisbon, where he had gone with little hope of recovery.

Besides his sermons and some hymns (the latter to be found represented in probably every hymn-book in the country), Dr. Doddridge was the author of "The Rise and Progress of Religion in the Soul," and of "The Family Expositor," both of which were very popular, and have been often reprinted.

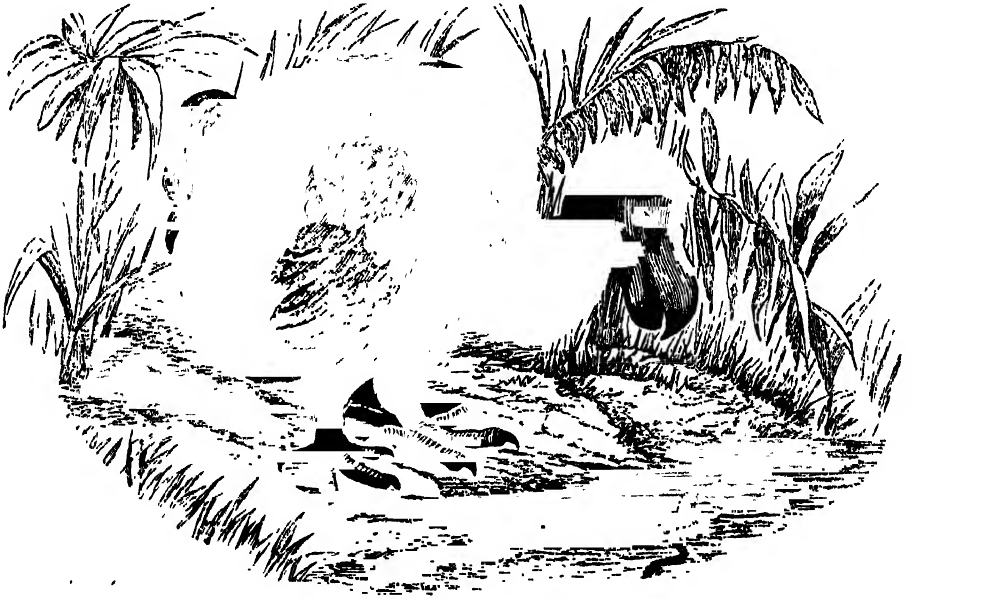
Two accounts of his life have been published, the first by Job Orton; the second, in the "Biographia Britannica," by Dr. Kippis, the editor.

DO'DO (*Didus ineptus*), a bird of the order COLUMBÆ, was an inhabitant of the island of Mauritius at the time of its discovery in the sixteenth century by the Portuguese, who christened it *Duodo*—*i.e.* simpleton. We know nothing positively of the inhabitants of the island (which by the Portuguese was called Cerne) till the arrival of the Dutch in 1598.

In the "Voyage to the East Indies, in 1598, by Jacob van Neck and Wybrand van Warwijk," there is a description of the *walgh-vögels* (dodo), in the island of Cerne, now called Mauritius, as being equal in size to our swans, with large heads and a kind of hood thereon; no wings, but in place of them three or four black little pens, and their tails consist of four or five curled plumelets of a grayish colour. In the description of the island of Cerne by De Bry ("Quinta Pars Indiæ Orientalis," &c., 1601.), will be found the earliest engravings of the dodo; in the frontispiece, surmounting the architectural design of the title-page, a pair of these birds stand on the cornice on each side.

Clusius in his "Exotica," 1605, gives a figure of the dodo taken from a sketch from nature by a Dutch voyager, who had seen the bird in 1598. He also describes a dodo's leg cut off at the knee, which he saw at Pauw's house in Leyden. He adds a note as to the name *walgh-vögel* (nauseous bird), which the Dutch sailors had given this bird, partly, he says, because the flesh after long boiling did not become tender, but remained hard and unpalatable, except "the breast and the gizzard, which they found to be of no bad relish, partly because they could easily get many turtle-doves, which were much more delicate and pleasant to the palate." We find two other names at this time for the dodo—Dronte, the significance of which is unknown, and Dodaars, which Professor Schlegel has shown to be a common name of the little grebe (*Podiceps minor*), which was recalled to the recollection of the Dutchmen by the dodo's round stern and the little tuft of feathers representing the tail; at the same time it was near enough to the original name, Duodo, to seem very appropriate. From this time onwards the dodo was described by many, and several were undoubtedly brought alive to Holland. Herbert in his "Travels" (1684) describes and figures the dodo, and it is also described and figured well by Bontius (1658).

The painting in the British Museum of the dodo is the copy of an original taken from a living specimen sent to Holland from the Mauritius while that island was held by



The Dodo (*Didus ineptus*).

the Dutch. This copy was the property of Sir Hans Sloane, and afterwards of Edwards, by whom it was deposited in the museum. Formerly a perfect specimen, noticed by Ray, existed in the Tradescant Museum. This specimen afterwards passed into the Ashmolean Museum at Oxford, where it existed so late as 1700; it subsequently fell into decay, and the head and a foot are the only existing relics of it. A breastbone of the dodo is preserved in the museum at Paris, and a skull, which before formed part of the museum of the Duke of Gottorp, has been discovered in the museum of Copenhagen; a leg has also for long found a resting-place in the British Museum.

It would appear that about the middle of the seventeenth or beginning of the eighteenth century the dodo disappeared. Nothing was heard of it; and we only know that it does not now exist in the islands which abundant testimony proves it to have once inhabited. In 1865 hundreds of osseous remains of the dodo were discovered in the Mauritius, and a complete or nearly complete skeleton has been set up in the British Museum, and is fully described by Professor Owen in the *Proceedings of the Zoological Society* for 1867. This discovery quite set at rest the vexed question of the dodo's affinities. It was at once seen that this bird could no longer be placed among the ostriches, or emus, or vultures, but was in reality an aberrant gigantic pigeon, connected with the ordinary members of that group through the curious Tooth-billed Pigeon. [See DIDUNCULUS.] The dodo was a bulky and heavy bird, larger than a swan, and weighing sometimes as much as 50 lbs. It had a long and strong bill, with the basal portion of the upper mandible depressed and membranous. The apical part of this mandible was strong, horny, much arched, hooked, and acute, giving the organ a great resemblance to that of a vulture. The nostrils were placed in the sides of the membranous base of the upper mandible, and in all respects the structure of the bill presents a great similarity to that occurring in the didunculus. The feet of the dodo were short and exceedingly stout, and although presenting a certain resemblance to those of a pigeon, indicated clearly enough that their possessor was a strictly

terrestrial bird; indeed, its wings being very short, and furnished only with soft decomposed feathers, like the well-known ostrich plumes, were quite incapable of raising it from the ground. From this rudimentary condition of its wings the dodo was long regarded as allied to the Struthious birds. The body of the dodo seems to have terminated in a rounded extremity, and to have been destitute of true tail-feathers, but a tuft of plumes similar to those of the wings occurred low down on its back, and probably represented the tail-coverts. The plumage of the dodo was blackish, with the light feathers of the wings and so-called tail pale fawn colour.

The causes of the speedy extinction of the dodo are not far to seek. Its rudimentary wings, and its heavy, bulky body must have rendered it an easy prey to the animals, as dogs, cats, and swine, introduced by the European colonists. A similar fate has overtaken a closely allied bird, the SOLITAIRE, which inhabited Rodriguez.

DODO'NA, the most ancient oracle of Greece, was probably situated in the valley of Yanina, in Epirus, but its exact position has never been ascertained. The temple at Dodona was dedicated to Jupiter, and was of Pelasgian origin. The oracles were delivered from an oak, or rather, more probably, from a grove of oaks. Some also speak of beech-trees. The will of Zeus (evidently under the conception of him as the god of the sky) was declared by the rustling of the wind through the leaves and branches, and the slight clanking of light cymbals fixed for that purpose to the boughs and stirred by the gentlest breezes. Priestesses, few in number and aged, interpreted the signs. The trees were cut down and the temple at Dodona was entirely destroyed by Dosimachus, the Ætolian prætor, B.C. 219. It probably was never restored, for it did not exist in the time of Strabo. The inflammable fountain, near the ancient temple, was in all probability the cause of that site being fixed upon for the delivery of oracles. The natural philosopher and poet of Rome, Lucretius, thus describes this remarkable phenomenon:—

> "A fount there is, which, though cold itself,
> With instant flare the casual flax inflames
> Thrown o'er its surface; and the buoyant torch
> Kindles alike immediate, o'er its pool
> Steering the course th' ethereal breeze propels."

This description appears to be confirmed by Pliny, and at the present day we find that in Illyria and Zante, which are no great distance from the site of Dodona, there are several pitch springs, which according to Herodotus were in existence above 2300 years ago.

DODSLEY, ROBERT, was born in 1709, at Mansfield, in Nottinghamshire. He was apprenticed to a stocking-weaver, but disliking the business he became a footman. While in the service of the Hon. Mrs. Lowther he published by subscription, in 1732, an octavo volume of poetical pieces, under the title of "The Muse in Livery, or the Footman's Miscellany." The poetry was of no remarkable merit, but attracted attention from the situation of the author. He continued throughout his life to produce a number of works of varying degrees of merit, both in prose and verse.

In 1750 appeared anonymously his ingenious and well-known little work, "The Economy of Human Life," which was long extremely popular. In 1758 he produced his last play, the tragedy of "Cleone," which was acted at Covent Garden with extraordinary applause, and drew crowded audiences during a long run. When it was published 2000 copies were sold the first day, and the work reached a fourth edition within the year. Its merits scarcely deserved such a decided and profitable success. He died in 1764. Dodsley's merits as an author are now rated at their just level, but he will always be a figure in English literature owing to his connection with great authors as their publisher. He started as a publisher in 1735, and had great success. Among other splendid ventures was that of Dr. Johnson's "London," which cost Dodsley but 10 guineas! Two other things give Dodsley a place in the memory: he started the *Annual Register*, which still continues its useful career, and he brought out an excellent collection of old English plays in twelve vols., still a favourite work.

DOE, JOHN, and **RICHARD ROE,** fictions of English law up to the middle of this century. As these imaginary personages are even now alluded to, and were old familiar figures up till recent times, so that one cannot be acquainted with English literature without often running against them, it seems necessary to show the manner in which they were used by, and seemed serviceable to, our forefathers.

An action for debt, &c., between Jones and Smith, wherein Jones claimed so much money from Smith, was then, as now, called Jones *v.* Smith; but until 1852 an action for land, where Jones claimed to oust Smith from the enjoyment of certain land, which we will assume Jones to consider really to belong to him (Jones), *i.e.* an action of ejectment, by no means bore such a title. A certain fictitious John Doe would purport to have received a "demise" of part of Jones's property, that is, Jones became the *lessor of the plaintiff* (Doe), and, in fact, suitable leases, &c., would be executed by Jones in favour of this fictitious tenant, Doe. Thus armed John Doe, by his attorney, would serve a summons upon an equally fictitious Richard Roe, who he alleges came and "with force and arms, that is to say, with swords, staves, and knives, entered into the said tenements with the appurtenances which the said W. Jones had demised to the said John Doe in manner and for the term aforesaid, which is not yet expired, and ejected the said John Doe out of his said farm, and other wrongs to the said John Doe then and there did, to the great damage of the said John Doe and against the peace of our said Lady the now Queen. Wherefore the said John Doe saith that he is injured and hath sustained damage to the value of £50, and therefore he brings his suit," &c. The next step after the recital of this purely imaginary affray with "swords, staves, and knives," was for the fictitious defendant, Roe, to serve a notice upon Smith, the actual tenant, which of course is obligingly done for him by John Doe's lawyers. Richard Roe's notice was somewhat as follows:—"Mr. A. Smith, I am informed that you are in possession of or claim title to the premises in this Declaration of Ejectment mentioned, or to some part thereof; and I being sued in this action as a *casual ejector* only, and having no claim or title to the same, do advise you to appear next . . . Term in Her Majesty's Court of Queen's Bench at Westminster, by some attorney of that court, and then and there, by a rule to be made of the same court, to cause yourself to be made defendant in my stead; otherwise I shall suffer judgment to be entered against me by default, and you will be turned out of possession.—Your loving friend, Richard Roe" ("Blackstone's Commentaries," vol. iii.)

Thus, the action being at first by the fictitious John Doe (who is supposed to hold a lease off Jones) against the fictitious Richard Roe for forcibly ejecting him from his property, is called "Doe *demise* Jones *v.* Roe," and is met by Roe purporting to declare that though he has ejected Doe (according to the fiction), he has done so as a *casual ejector* merely, in the interests of Smith. Smith, the puppet pleads, is the real ejector, and unless Smith comes forward he (Roe) will submit to the damages, involving of course Smith's dispossession. Upon this Smith comes forward and applies to be made defendant instead of his "loving friend, Richard Roe;" this being agreed to, the action becomes "Doe *demise* Jones *v.* Smith," and is so fought out.

This curious procedure was adopted to avoid the ancient

dilatory and expensive modes of recovering landed property from wrongful possessors at the close of Edward II.'s reign; for if Smith did *not* come forward poor Richard Roe's case was adjudicated on by default, and the triumphant John Doe (with the actual plaintiff, Jones, in his train) entered into possession at once. It lasted for five and a quarter centuries, incredible as it may seem, till in 1852, by the statute 15 & 16 Vict. c. 76, Parliament laid rough hands upon poor old John Doe and Richard Roe, who then ceased to exist, together with the fictions among which they had so long figured. The simple process by writ of ejectment, in the names of the real parties and specifying the whole property in dispute, has taken their place. Lord Mansfield has put the legal aspect of this ancient procedure in a few sentences as follows (we add the names of the parties adopted above for clearness):—

"An ejectment is an ingenious fiction for the trial of titles to the possession of land. In *form* it is a trick between two to dispossess a third by a sham suit and judgment. The artifice would be criminal unless the court converted it into a fair trial with the proper party. The control the courts have over the judgment against the casual ejector (Roe) enables them to put any terms upon the plaintiff (Jones) which are just. He (Jones) was soon ordered to give notice to the tenant in possession (Smith). When the tenant in possession asked to be admitted defendant the court was enabled to add conditions, and therefore obliged him to allow the fiction and go to trial on the real merits."

The actual process of an old-fashioned suit of ejectment forms the basis of Warren's most interesting novel, "Ten Thousand a Year," first published in 1841, when the system was in full operation. It has passed through many editions.

DOG. Under the title of dog (genus Canis, Linn.; family CANIDÆ of modern writers) is comprehended not only the faithful domestic quadruped to which the term more particularly belongs, but all the animals of the carnivorous order which are in immediate alliance with it, as the wolf, the jackal, the fox, and the HUNTING DOG (Lycaon), which constitute the representatives of a natural family.

It is to the dog properly so called that the present article is restricted. The other species are treated of under their respective titles.

Linnæus characterizes the *Canis familiaris* as "Canis caudâ sinistrorsum recurvata" (dog with tail curled towards the left); and his description, after enumerating eleven varieties, is minute and accurate. Into such details, however, we need not enter. All are acquainted with the habits, manners, and peculiarities of this faithful animal, which, domesticated from the earliest times, has followed man through all countries as his servant and friend, and inhabits alike the ice-bound regions of the arctic circle, those of the temperate latitudes, and those of the torrid zone.

In size, in the development of the limbs, in the length of the tail, in the form of the head, muzzle, and ears, in the quality and length of the hair, and in colour the domestic dog offers an endless variety. To many of these varieties distinguishing names have been given, as mastiff, bulldog, hound, terrier, spaniel, &c., until at last we come to anomalous breeds, termed mongrels, "of no mark or likelihood," and of intermingled lineage.

One of the most interesting questions in this connection is the origin of our domestic breeds. The question as to what was the parent stock of this domestic animal, so varied in its characteristics, and so ever-varying, has been a fruitful source of discussion among naturalists for many years.

Some celebrated naturalists, and among them Pallas, have contended that the dog never existed in a state of primitive nature. They assign to it an artificial origin, and regard it as the result of the intermixture of several species closely allied to each other, among which may be enumerated the wolf and the jackal. Pennant and others, again, regard the dog as a descendant of the jackal, and others of the wolf. Darwin discusses the question at length in his "Animals and Plants under Domestication," to which work we are indebted in the following resumé for many facts. There is no doubt that dogs were domesticated at a very early period in man's history. In the Old Testament they are often mentioned, but usually as unclean beasts, being regarded in the same light as they are by most Oriental people to this day. A solitary exception to this rule occurs in the Book of Job, where the dog is referred to as the guardian of flocks of sheep. In Egypt the dog was domesticated and was held in great veneration, divine honours being paid to it. That several distinct breeds existed is shown by the drawings preserved on walls of tombs of great antiquity, which show how well-marked the breeds were, and how striking is the resemblance they present to our own varieties. The same evidence is offered by Assyrian monuments of an antiquity of 4000 and 5000 years. Nor is this the furthest that we can trace the domestic dog. In the kitchen-middens of Denmark, the heaps of refuse piled up by prehistoric men of the Neolithic period, are found bones proved to belong to some species of the genus Canis. These remains are conjectured, with great probability, to belong to a domesticated dog. During the same period in Switzerland there existed a domesticated dog partaking of the characters of our hounds and setters or spaniels. In the later bronze and iron ages in the same two countries dogs are known to have existed. Thus we have seen that at a very early period in different parts of the world man possessed domesticated dogs more or less identical in habits and structure with some of our breeds. It seems very improbable, *prima facie*, that only *one* wild species out of so many should be domesticated, seeing that to this day most of the wild Canidæ can be, and are often, tamed. This taming would necessarily be more easy of accomplishment at an early period before wild animals, unaccustomed to the presence of man, had acquired an instinctive fear of him.

The next point is the identity of structure in the genus Canis. This is so great that it is found impossible to draw a strict line of demarcation between, on the one hand, the dog, and on the other the wolf and the jackal, and again between the domestic and the wild varieties of the dog. Over and over again it has been pointed out how great is the resemblance shown by domestic dogs to the species of wolves and jackals inhabiting the same country. Thus Sir J. Richardson states that the Esquimaux dogs are not only extremely like in form and colour the gray wolf of the arctic circle (which differs considerably from the European wolf), but also nearly equal them in size. Again the same authority says—"The resemblance between the Northern American wolves and the domestic dogs of the Indians is so great, that the size and strength of the wolf seem to be the only difference. I have more than once mistaken a band of wolves for the dogs of a party of Indians; and the howl of the animals of both species is prolonged so exactly in the same key that even the practised ear of the Indian fails at times to discriminate them." Nor could Richardson detect any marked difference between the prairie wolf (*Canis latrans*) and the hare Indian dog. In Hungary so close is the resemblance between the wolf and the large sheep-dog of the plains that mistakes easily arise. Jackals again not only agree structurally with the smaller races of dogs, but, when tamed, exhibit many of the habits of our domestic dogs. The strong resemblance to them shown by the half-domestic dogs of Asia and Egypt has been pointed out by many naturalists.

The habit of barking, so characteristic of domestic dogs, seems to mark them out at once from the wild species.

But it appears that this habit is the result of domestication. On the one hand domestic dogs who have become wild lose this habit, and when redomesticated acquire it again; on the other hand jackals, wild dogs, and wolf-whelps reared by bitches acquire this habit in a state of confinement or semi-domestication. The period of gestation, about sixty-three days on the average, agrees in the wolf, jackal, and dog. In the majority of cases the domestic dog breeds freely with species of wolves and wild dogs, producing fertile offspring. Taking all these facts into consideration, the conclusion to which Darwin comes seems the only tenable one, namely, that "the domestic dogs of the world have descended from two good species of wolf (*Canis lupus* and *Canis latrans*), and from two or three other doubtful species of wolves (namely, the European, Indian, and North African forms), from at least one or two South American canine species, from several races or species of the jackal, and perhaps from one or more extinct species."

We shall not enter here into an enumeration of our multitudinous breeds of dogs; their respective qualities are well known to all. Man has availed himself of their sagacity, their courage, their powers of scent, and their fleetness. Volumes might be written on the intellectual and moral attributes of the faithful friend and companion of man, a creature in whom, as Darwin says, the love of man has become instinctive.

The dog is born blind, and begins to see about the twelfth day. Its duration of life is from fourteen to twenty years. Its teeth commence their change about the fourteenth month, and it attains to maturity in two years. The female has from six to ten mammæ, not always in pairs. The number of young at a birth is usually from five to eight, sometimes one or two more.

The numerous varieties of the domestic dog may be classed under the following headings, WOLF-DOGS, GREY-HOUNDS, SPANIELS, HOUNDS, MASTIFFS, and TERRIERS. The more important breeds will also be noticed under their respective headings. In our Plate are given representations of the Tibet dog and the common wolf.

DOG-BANE is a common name for the genus Apocynum, the type of the order APOCYNACEÆ. There are five species, of which three are natives of South Europe and temperate Asia, and two are indigenous in North America. They are perennial herbs, with erect and sometimes shrubby stems, opposite leaves, and small flowers in terminal cymes. The corolla is bell-shaped, with five scales inside, alternate with the stamens, which do not project beyond the throat. The ovary consists of two carpels, immersed in the disc at the base, but otherwise free. The seeds are crowned with long, deciduous hairs.

The bark is fibrous, and is utilized in the two species *Apocynum cannabinum* and *Apocynum hypericifolium*, as a substitute for hemp by the natives of India. The former species, as well as *Apocynum androsæmifolium*, are emetic, diaphoretic, and diuretic. The last-named species is the "Fly-trap" of North America; flies are attracted by a sweet liquid secreted by the scales, and then caught by a sudden movement of these to the centre. The milky juice of the various species dries into a substance much like india-rubber.

DOG-DAYS, a term applied to the hottest period of summer, which, in ancient astronomy, was the time when Sirius, or the Dog-star, rose immediately before the sun. According to the almanacks, the dog-days begin on the 3rd of July, and end on the 11th of August. But the heliacal rising of Sirius, owing to the precession of the equinoxes, is later in the year; hence our dog-days have not now the same relation to the star Sirius as formerly.

DOGE, the well-known title of the supreme magistrate of the ancient Venetian republic (as well as the title of the president of that of Genoa), is merely a modification of the Latin *dux*, a leader. Hence Shakspeare's "Duke of Venice" is absolutely correct as a translation, our "duke" being the same word "dux" in yet another dress. Venice was founded in 420. The doges began in 697. The doge was elected by the whole people, in universal suffrage, from the ranks of the patricians. At first, as Mr. Ruskin has pointed out in his "Stones of Venice" (vol. i., Appendix), his power was almost unchecked. He was practically a king. But in 1033 considerable checks, especially against hereditary dogeship in any family, were introduced, and in 1172 the great change was made from a democracy to an oligarchy, the nobles seized the whole power, and a committee of twelve of them appointed the doge. Fifty years later the curious "inquisition on the doge" was appointed, a body which, so soon as the prince was dead, examined his acts, and if through any of them the state had suffered mulcted his estate in a suitable fine. Again another half century and the doge's election was altered in a most complicated manner: a committee was elected by the nobles, which committee proceeded to name another, that a third, that a fourth, and so on, each body differing in number and most in official rank, till the ninth successive body (numbering forty-one) chose the doge. Surely nine successive siftings should have satisfied the raging jealousy of these patricians. Their object, it need hardly be said, was to annul the power of any one family, however influential. But the decay of the state was lamentable. Checks and counterchecks were multiplied till the doge (except in times of war, when he was commander-in-chief) was rather a dignified symbol of the state than its head and chief. He could not marry his children as he would, nor hold what property he pleased; he was in actual truth a prisoner to the Venetian state, and never allowed to leave it. The date when the nobles declared their power hereditary is purposely left obscure, and indeed it was not all done at once. But it is quite certain that 1310 was the date of the establishment of the famous "Council of Ten," which after that must be regarded as the supreme power of the state, controlling the doge. Ruskin suggests that 1297 be taken as the period of the completion of the aristocratic yoke upon the neck of the state; in which case the 1100 years of life of Venice are divided into six centuries of monarchy, 697-1297, and five of oligarchy, 1297-1797. Napoleon then blotted Venice from the map of states. There were in all seventy-three doges of Venice, the last being Lodovico Manin, dismissed by Napoleon in 1797, the first Anafeste, elected 697. The portraits of all are exhibited in the Doge's palace at Venice; that is, of all but one, FALIERO, who conspired against the republic, and whose death was not sufficient punishment without his memory being stamped by the reproach of the empty frame there in its proper rank on the wall. In Genoa the dogeship was instituted in 1339 on the ancient Venetian model. Doria (1528) reduced the tenure of office to two years, and also adopted the complex elective machinery of the thirteenth-century Venetian reform.

DOG'FISH is a name commonly given to several small species of SHARKS, a group of fishes forming a suborder of the CHONDROPTERYGII. The common dogfishes of our own coasts are species of the genus Scyllium. In this genus there are two dorsal fins without spines and one anal. The eye is not provided with a nictitating membrane, but spiracles are always present. The teeth are small. The young are brought forth inclosed in horny cases, the familiar "mermaids' purses."

The Large-spotted Dogfish (*Scyllium catulus*) is from 2 to 3 feet in length, with a large head, the snout prominent and slightly pointed, and a rough skin. The general outline of the body is cylindrical, the colour is a brownish-gray, slightly tinted with a dusty red, and marked with very numerous spots of brownish-black; the belly is whitish

and very smooth. At its full growth this fish weighs about 20 lbs. It is very voracious, devouring great quantities of fish, and it does not hesitate to attack the fishermen, and especially bathers in the sea. On the British coasts it abounds, especially off the Orkneys. In some parts of Scotland it is eaten by the poor; but its flesh is hard, and has a disagreeable musky odour. Its rough skin is used, under the name of "fish skin" and "shagreen," by joiners and other artificers in polishing various substances, and also for covering spectacle-cases and similar articles.

The Small-spotted Dogfish (*Scyllium canicula*) closely resembles the preceding, but the upper part of its body is crowded with small, dark, reddish-brown spots on a pale reddish ground, the spots being rather larger and less numerous on the fins. It is a very common species on the south coast of England, where it feeds on small fish and crustacea, lying in ambush to surprise its prey. Dr. Günther suggests that "it would be worth while to apply the fins of these and other sharks, which are so extensively used in China for making gelatine soups, to the same purpose in this country, or to dry them for exportation to the East."

A closely allied genus is Pristiurus, a species of which, *Pristiurus melanostomus* (the black-mouthed dog-fish), so called from the colour of the interior of its mouth, is a common species in the Mediterranean. Its average length is from 2 feet to 2 feet 6 inches; its colour on the head and upper part of the body is a light brown; and along each side run two rows of ocellated spots. Another common British dogfish belongs to the genus ACANTHIAS.

DOG'GER, a name used in Yorkshire to denote a band of reddish-brown ferruginous sands about 30 feet thick, and forming one member of the Lower Oolite in that district.

DOG'GERBANK, a very extensive sandbank in the North Sea, between the east coast of England and the west coast of Holland, extending from near Flamborough Head, in the county of York, for 354 miles towards Jutland. It is noted for its cod-fishery, also for being the site of an obstinate battle between the English and Dutch fleets in the summer of 1781, which resulted in both parties being so much disabled that neither could claim a victory.

DOGGETT'S COAT AND BADGE are two prizes annually awarded for skill in rowing on the Thames, and the competition for which always excites much interest. Thomas Doggett, an eminent actor of Drury Lane, on the first anniversary of the accession to the throne of George I. (August 1, 1715), gave a waterman's coat and badge to be rowed for by six young watermen in honour of the day; and at his death left a sum of money to continue the same gifts annually for ever. Other prizes have since been added, and each of the six rowers receives something. The competition is confined to young watermen whose apprenticeship expired in the previous year, each rowing in a boat by himself, with short oars or sculls. The race is from London Bridge to the Old Swan at Chelsea, and it takes place when the current, by the recession of the tide, is strongest against the rowers.

DOG'MA (Gr. *dogma*), a word borrowed from the Greek, is frequently used as implying an established principle, a fundamental article of belief derived from undisputed authority, and is generally applied to what are deemed to be the essential doctrines of Christianity, which are drawn from the Scriptures or from the authority of the fathers. Hence that branch of divinity called dogmatic theology is an exposition and assertion of the various articles of the Christian faith as founded upon authority acknowledged by Christians in general, and is distinguished from scholastic theology, which assumes to establish the truth of the Christian doctrines by argument.

In this sense the word dogma has been understood to signify a doctrine founded on Scripture or tradition, or by the authority of a council of the church, &c., and advanced not for discussion but belief. But as this method of stating truth easily degenerates into the assertion of opinions without ground, and without regard to the aspect they may present to others, *dogma* and *dogmatism* have gradually come to be regarded by many as synonymous with assertion without proof. In a more liberal sense, however, the word may be held to have the same meaning as the German *dogmen*—that is, simply doctrines; and dogmatic theology is that branch of theology which treats of the systematic arrangement of the doctrines of Christianity. In Germany the history of dogmas or doctrines has been raised to the rank of a distinct branch of sacred science. In this country the facts with which it deals have received only passing notice in treatises on systematic theology, although the pursuit of the inquiry is characteristic of Protestantism. In the Roman Catholic Church the study is viewed with disfavour, as endangering the unity of the faith; and even among some sections of Protestants there is no small prejudice against the idea of a "development" of Christian doctrine, which seems to be involved in its having a history. Their view is that the Bible is a revelation of theological doctrines, which need only to be correctly interpreted and arranged in logical order. If this were so, the task would be comparatively a simple one, and might have been carried out ages since. It has frequently been attempted, but devout and learned men have widely differed in their several conclusions, and there appeared to be two alternatives—either the revelation was incomplete, and it is impossible to attain any certain knowledge in regard to doctrine; or it required to be checked or supplemented by an unerring living authority. The former is the sceptical, the latter the Roman Catholic alternative.

Those, however, who pursue the study of dogma as a science object to both these conclusions, and contend that all difficulty is removed by regarding the Bible as a revelation, not solely or directly of doctrine, but of religion—the inspired record of the great historical events by means of which the religious fellowship of man with God has been established, and gradually elevated to its perfect form in Christianity. Doctrines or general principles bearing on the relation of God to man are indeed contained in the Bible, but only as they are involved in the great realities that the Bible makes known to us; and the leading doctrines in theology have been established, not merely by the application of grammar and logic to the text of Scripture, but by personal apprehension and experience. So Augustine learned the doctrine of original sin and divine grace by finding in his own experience the power of inward corruption on the one hand, and the deliverance wrought by the gospel on the other. In the same way Martin Luther proved the truth of justification by faith by finding peace of conscience in this source when works of merit and righteousness had all failed. In neither instance was anything added to the Christian religion, which is ever one and the same, but the knowledge of it became clearer; and truths already in the Christian revelation came with all the force of new light to the apprehension and the experience of the church. There are some doctrines in every system that are merely sectarian; that is, adopted only by one particular branch of the church—such, for instance, as the Anglican doctrine of baptismal regeneration, the Roman Catholic doctrine of the immaculate conception of the Virgin Mary, and some of the doctrines of both Luther and Calvin. Other doctrines have, ever since their first formulation, been accepted by the great majority of Christians. To depict this succession or evolution of views, with their struggles and modifications, and trace the different ways in which the several doctrines were at different periods formulated and embodied in the creeds, is the object of a history of dogma, for which there is a chair in the Protestant universities of Germany.

The materials for such a history are abundant and of great interest; and a study of them is very helpful in forming an opinion as to the value of the several dogmas upon which the Roman Catholic and other Christian churches have from time to time pronounced. The earlier period of Christianity was fruitful in speculations as to the rightful interpretation of Scripture on many points, and in proportion as "heresies" arose so were the limits of divine truth defined within precise and often narrow bounds. The controversies chiefly arose on questions relating to God and the Trinity, the incarnation and person of Christ, original sin and regenerating grace. From the second to the eighth century various opinions on these subjects were discussed, condemned, and stamped as heresies, this being the object of several of the early councils of the church. In the keen strife for doctrinal precision it is questionable whether much of the spirit of Christianity was not overlooked; at any rate adhesion to certain set dogmas as defined by the church came to be clearly regarded as the one essential of saving faith. It may be that only the Athanasian creed was preceded by the distinct announcement of its acceptance being necessary to salvation, but practically all the other creeds were regarded in the same light. In the great upheaval of the Reformation most of the creeds sanctioned by the early councils were tacitly adopted as being in accordance with Scripture; and the Nicene creed, in spite of all the working of modern thought, remains the most generally accepted of all Christian collections of dogmas. In the Church of Rome the lines of dogmatic theology are still sharply drawn, and belief is exacted in all the various definitions by the church, down to that of the infallibility of the pope as formulated in 1871–72, and the same holds good of the Orthodox Church (Greek Church). Beyond these older churches this tight bracing up of religious thought within hard and fast lines is felt to be unsatisfactory, and what in the eyes of the members of later Christian societies is a broader foundation, as well as a more living conception, has been sought for Christianity in the study of the teaching and spirit of its author, rather than within the narrower field of dogma, however ably defined.

DOGS, ISLE OF, or **POPLAR MARSHES,** a peninsula on the Thames, in the county of Middlesex, 3½ miles south-east of St. Paul's, so named, it is said, from the royal hounds having been formerly kept there. It contains the West India and Millwall Docks, and large shipbuilding yards.

DOG'S-TAIL GRASS (*Cynosurus cristatus*), a well-known pasture grass abundant in all natural and artificial grass land. Although this grass forms so constantly a portion of all good pastures, it is chiefly on account of the fineness and closeness of its herbage that it is valuable, the quantity of hay that it produces being inconsiderable. The roots penetrate deep under ground, and accordingly it remains fresh and green after most other grasses are burned by a continuance of dry weather. Cynosurus is easily recognized by the comb-like bract at the base of each spikelet.

DOGTOOTH SPAR, a name applied in Derbyshire to CALCITE occurring in sharp pointed scalenohedra, which roughly resemble in shape the canine teeth of the dog.

DOG-WHELK. See WHELK.

DOG-WOOD, the English name of various deciduous-leaved shrubs belonging to the genus CORNUS.

DOL, a town of France, in the department of Ille-et-Vilaine, 15 miles south-east of St. Malo. It is of little importance now, but it was formerly one of the chief fortresses on the frontier between Brittany and Normandy. The cathedral, which was the metropolitan church of all Brittany, is said to have originated in a monastery founded by the British bishop St. Samson, who fled hither from the Saxon invaders of his own country. It has some stained glass of the thirteenth century. In the vicinity are a menhir, 30 feet high, and the granite rock of Mount Dol, 200 feet in height. The population of the town in 1884 was 4500.

DOLABEL'LA, one of the great patrician families of the Cornelian gens or clan of ancient Rome. Many a Cornelius Dolabella graces the annals of the republic. The chief are the following:—

PUBLIUS CORNELIUS DOLABELLA, consul B.C. 283, during the great Italian rising against Rome, when the whole north of Italy, Etruscans, Umbrians, and Gauls (the Gauls "this side" the Alps) were united, and the south of Italy, headed by the Samnites, was preparing to join them. But a tribe of Italian Gauls, the Senones, having begun actual hostilities and gained a military advantage, Dolabella advanced with his whole force and literally annihilated them—put all the nation to the sword, and erased their name from the map. A victory over the Boii, the next neighbouring Gallic tribe, brought all the Gauls to their knees, alarmed at such terrible severity, and a separate Gallic peace was signed next year, 282 B.C.

CNÆUS CORNELIUS DOLABELLA, consul B.C. 81, during the intestine faction war, was one of Sulla's partisans. Nevertheless Cæsar, then a youth, attacked him in 77 for extortion in his province. It is hardly necessary to add that Dolabella was acquitted, but the lesson was felt.

PUBLIUS CORNELIUS DOLABELLA, consul B.C. 44, is the best known of the name. He was the son-in-law of Cicero, and his utterly reckless conduct, both politically and morally, was a source of torture to the cautious, prudent, time-serving Cicero. In the civil war he joined Cæsar, and showed such capacity (besides representing one of the noblest Roman houses) that Cæsar made him his admiral. The two fleets of Pompey, however, joined and fell on Dolabella as he lay in the Gulf of Quarnero in Illyria, entirely destroying his ships and putting him to desperate measures on the island of Veglia to defend his army from capture. Dolabella still continued in command, and was at Pharsalia (48), in the African expedition (46), and in the great Spanish campaign of 45. In return for his services he was made consul in 44, although during Cæsar's absence in the East, in 47, he had kept Rome in a tumult with frequent riots between armed bands, recklessly advocating the abolition of creditors' claims and of house rent, till Mark Antony called out the soldiers and forcibly restored order. Possibly it was the opposition of Mark Antony at this time, and at the time of his nomination to the consulship, which threw Dolabella into the arms of Brutus and Cassius at Cæsar's assassination. But Antony was equal to his man, and at once appointed him to the rich province of Syria. Dolabella swallowed the bait, changed sides, marched for his province, and began a wholesale plunder of the Greek cities. Cassius had taken this same province of Syria by appointment of the senatorial party; and Dolabella soon had Cassius upon him. He was no match for Cassius, and took refuge in the fortified town of Laodicea B.C. 43. When the place fell he caused himself to be slain by one of his slaves, rather than fall into the hands of Cassius.

DOLCI, CARLO, a distinguished painter of the period of decadence of the great Italian schools. He was born at Florence in 1616, and though his method of working was extremely slow and laborious, the finish he attained was so great that, as far as mere workmanship went, he excelled all his contemporaries at Florence. He is deficient in the highest qualities of genius; he lacks fire and imagination, sometimes he falls into a weakly sentimental tone; but his pictures are almost always pleasing. He rarely painted large pictures, and his figures (often busts only) are frequently less than life size. They are all on religious subjects: the "Suffering Christ," "Mater Dolorosa," &c., being his favourite themes. He died at Florence in 1686. He is ranked among the Eclectics, the originators of which

school were the Caracci, followed by Domenichino, Guido, &c.; but Carlo Dolci was not actually a pupil of this school, though he adopted its methods. His master was Jacopo Vignali.

DOLE, a town in the department of Jura in France, stands on the right bank of the Doubs, a feeder of the Saône, about 220 miles south-east from Paris on the road to Geneva, and had 11,437 inhabitants in 1881. It is pleasantly situated on the crest and slope of a hill; the streets are rather steep, but well built and ornamented with fountains; and the neighbourhood is prettily laid out in gardens, vineyards, and promenades. The parish church is a handsome Gothic building. The ancient tower of Vergy still stands, and is used as a prison. The other remarkable buildings are—the New Prison, the former Jesuit college, the court-house, the museum, and the bridge over the Doubs. The town has tribunals of first instance and of commerce, a college, public library, school of design, several hospitals, and a theatre. It is well situated for trade on the canal that joins the Rhone and Rhine. Hosiery, tiles and pottery, chemical products, vinegar, and beer are manufactured; there are also iron-smelting furnaces supplied with ore from the neighbouring mines, flour-mills, and establishments for the rearing of silk-worms; corn, flour, wine, wood, charcoal, marble, and iron enter into the commerce of the town. A ruined Roman road, aqueduct, and amphitheatre still exist. It formerly belonged to the dukes of Burgundy, and is famous for its sieges. In 1485 the inhabitants gallantly repulsed the Duke of Bourbon, who wished to wrest the place from Mary of Burgundy; but in 1479 the French took it by treachery, massacred the inhabitants, and burned the town. Of the few buildings that escaped this destruction, the tower of Vergy alone still exists. Dôle afterwards came into the hands of the Spaniards with the rest of Franche-Comté, of which it was for some time the capital. Charles V. added to the fortifications in 1530. In 1636 it was fiercely but ineffectually besieged by the Prince of Condé; Louis XIV. took it in 1668, and again in 1674, when he demolished the fortifications. By the treaty of Nimeguen the town, together with the whole of Franche-Comté, was made over to France. Dôle is the *Dola Sequanorum* of the Romans.

DOL'ERITE is a coarse-grained BASALT, that is, a basalt in which the crystals are larger and more distinct than in the ordinary basalts and anamesites. The amount of amorphous base is small, sometimes extremely so. Distinct dark-coloured prisms of augite are generally to be seen, and the rock varies in colour from gray to black.

DOLGEL'LY, a town of Wales, the capital of Merionethshire, and the terminus of the Ruabon and Dolgelly Railway, 258 miles from London, is situated on the south bank of the river Wnion, about a mile above its junction with the Maw. The town stands in a pleasant valley, and consists mostly of a collection of houses—there being no streets in the ordinary acceptation of that term. Coarse woollen cloths, called "webs," and flannels are manufactured, and there are extensive tanneries, fulling mills, and bleaching grounds in the neighbourhood. The church is a neat structure, and there are some places of worship for dissenters. The population of the town in 1881 was 3962.

DOL'LAR, a village of Scotland, in the county of Clackmannan, beautifully situated on an eminence near the river Devon, 11 miles east by north from Stirling. The well-known academy here was founded in 1819 from a bequest of £80,000 by Captain M'Nab, a native of the place. The buildings are handsome and commodious. In the vicinity are the interesting ruins of Campbell Castle, a name which it received by Act of Parliament in 1489 in exchange for that of the Castle of Gloom. It was reduced to ruins by Montrose out of enmity to Argyll, and perhaps also in revenge for the destruction of his own "House o' Airlie." One path to the castle passes through a most romantic chasm between walls of bare rock 200 feet high, and in some places not 6 feet apart.

DOL'LAR, a silver coin of several nations and various values. The chief is that of Canada and the United States, worth 100 cents = 4*s.* 2*d.* It is the descendant of the Spanish piastre or dollar, slightly reduced in value. Sometimes small gold dollar-pieces are used in America. [For subdivisions see DIME.] The word and coin also come from the German *thaler*, as Carlyle has pointed out ("Friedrich," xvii. 6). The silver in the Joachimsthal mines (Joachim's Valley) was fine, and the coins pure. "Let my ducat be a Joachimsthal one, then! the old Trader would say; a Joachimsthaler, or for brevity a *thaler:* whence Dollar now going round the world." The Prussian thaler (now equal to 3 marks) is worth 3*s.* The sign $ for dollar is the abbreviation for *scutum* (Lat., shield), alluding to the royal arms borne on the ancient piece.

DOL'LOND, JOHN, an eminent optician, was descended from a French refugee family settled in Spitalfields, London, and was born 10th June, 1706. His father was an operative silk-weaver, and his own boyhood was spent in the drudgery of a manufactory; he found time, however, to make considerable progress in the study of mathematics and natural philosophy, besides which he cultivated anatomy, and devoted his leisure moments to ecclesiastical history and several languages. He entered into partnership with his son, an optician, in 1752, and in about three years from this time commenced a series of experiments on the dispersion of light. In 1757 he made the decisive experiment which showed the error of Newton's conclusion respecting the proportional refrangibility of light in all media. Its results were contained in a paper which was printed in the *Philosophical Transactions* of the Royal Society for 1758, and in consequence of the discovery Mr. Dollond was enabled to construct what are called achromatic telescopes, or such as afford images of objects almost wholly free from coloured fringes. The discovery was rewarded by the council of the Royal Society with the Copley medal. He was elected a fellow of the Royal Society in 1761, but did not long enjoy the well-deserved honour, for he died of apoplexy brought on by over study in the same year.

DOL'OMITE, a mineral consisting of the carbonates of lime and magnesia in various proportions, provided that the amount of magnesia present is sufficient to constitute it more than an impurity in the carbonate of lime. Normal dolomite has equal proportions of the two carbonates—that is, 54·35 per cent. of lime carbonate and 45·65 of magnesia carbonate *by weight;* but these proportions are scarcely, if ever, found, and in practice it is not easy to draw the line between a dolomite and a magnesia-bearing calcite. Part of the lime or magnesia may be replaced by protoxide of iron. Ferriferous varieties, such as *tharaudite*, *ankerite*, *mesitin spar*, and *brown spar*, are of frequent occurrence; they pass into true CHALYBITE.

Dolomite occurs both crystallized and massive. The crystals belong to the rhombohedral system; the rhombohedral being the common form, the faces are frequently curved, and sometimes have a strong pearly lustre. The mineral is distinguished from calcite, which it strongly resembles, by its greater hardness (3·5 to 4) and specific gravity (2·8 to 2·9), and also by the fact of its effervescing very slightly, if at all, with hydrochloric acid, calcite effervescing energetically. When pure it is white with a slight grayish tinge; but it occurs in almost all colours on account of the impurities which it frequently contains. Dolomite often forms large mountain masses, in Styria and Carinthia for instance; many so called limestone strata being in part, if not altogether, dolomite, or as it is often called in such cases, magnesian limestone. Of this kind are the Permian limestones of Weardale and the Derbyshire hills, and much of the Devonian and Carboniferous limestone of North

America. The best British localities for dolomite are—Alston Moor in Cumberland, Laxey in the Isle of Man, and Wanlockhead in Dumfriesshire.

Von Buch has given good reasons for believing that in many, if not most, of the cases where dolomite occurs in large masses, it is the result of the alteration of limestone. This idea is borne out by the fact that limestone is frequently found altered to dolomite along cracks and joints, as, for instance, in the carboniferous limestone of the north of England and the south of Ireland. In the former case the altered rock is locally known as "dunstone." Again, a limestone would shrink on altering to dolomite—a shrinkage amounting to over 12 per cent. (according to Elie de Beaumont) if the resulting dolomite had one equivalent of magnesia carbonate for every one of lime carbonate, and in many instances dolomite masses have a cavernous structure. Two of the most probable theories put forward to account for the "dolomitization" of limestone (as this phenomenon is called) are—(1) the action of sea-water (which contains notable quantities of magnesia salts, especially the chloride), and (2) the local action of carbonated waters containing carbonate of magnesia in solution. Cases occur in the Alps of what were undoubtedly coral reefs in past geological epochs converted into dolomite; and it is an interesting fact that this action has been traced in existing reefs. Some dolomite, however, has certainly been precipitated as dolomite from salt lakes or inland seas—the magnesian limestone of the Permian system, for instance. The mineral was named after Dolomieu, a celebrated French geologist, who described it about the end of the last century.

DOL'PHIN (Delphinidæ) is a family of the CETACEA, characterized by the possession of numerous teeth in both jaws and a single blow-hole. Outside these characters the genera differ very widely. The true dolphins, the species of the genus Delphinus, are distinguished by their almost straight back, and by their attenuated, compressed, and prolonged muzzle, which bears some resemblance to a beak. The jaws are of equal length, and furnished with a very numerous series of teeth, upwards of 180 having been counted in some specimens; their form is slender, and slightly curved inwards, and they interlock during the closed state of the jaw.

The Common Dolphin (*Delphinus delphis*) is an inhabitant of the northern seas, the Mediterranean, and the Atlantic Ocean, occasionally making its appearance off our coasts. It is a remarkably active species, and notwithstanding its voracious and gluttonous habits was formerly highly esteemed for its flesh. Pennant records, on the authority of the celebrated Dr. Caius, that one which was taken in his time was presented to the Duke of Norfolk, who distributed portions of it among his friends. "It was roasted and dressed with porpesse sauce, made of crumbs of fine white bread, mixed with vinegar and sugar." The common dolphin feeds on fish, medusæ, and crustaceans. It usually attains a length of 6 or 8 feet. The body tapers towards the tail. The forehead is abruptly rounded, and the beak, about 6 inches in length, is separated from it by a transverse depression. The upper surface is black, the under white, and the flanks of a grayish hue. Like so many of the order to which it belongs the dolphins are gregarious, and their merry gambols as large herds gather round ships are well known. From the earliest times they have excited great interest. The Greeks looked on them as peculiarly friendly to sailors, their playing and tumbling before a storm warning the mariners to make with all speed for a place of refuge. The well-known story of Arion would argue their possession of æsthetic tastes and a critical judgment which seem to have degenerated in their modern descendants. The Bottle-nose Dolphin (*Delphinus tursio*), also a British species, is larger and has less numerous teeth than the common species. There are many other species of this genus found in all parts of the world.

To this family are referred the genera Phocæna (PORPOISE), Globiocephalus (CAAING WHALE) BELUGA, Orca (GRAMPUS). The fresh-water dolphins, belonging to the genera PLATANISTA and INIA, are sometimes placed in a distinct family, Platanistidæ.

The name dolphin is frequently given by sailors to fishes of the genus CORYPHÆNA.

DOM is a contraction of Lat. *dominus*, lord, and in the middle ages was applied as a title to the pope and his court. The promenade on the lofty rocks above the Rhone at Avignon (where the popes long held their residence, see AVIGNON) retains to this day its mediæval name of *Le Rocher des Doms*. The word was applied later on to several not such elevated dignitaries in the church. It is also used as equivalent to "cathedral" in many parts of Germany, the *dom* or *dom-kirche* being a familiar word to travellers in the great cities. The Italian equivalent is *duomo:* the *dom* at Cologne and the *duomo* at Milan occur to everyone as instances. But it is possible, if not indeed probable, that this latter use of the word is derived either from the Greek and Latin word *domus*, a house, as applied to the house of houses, chief above all houses, the Lord's house—or from D. O. M. (*Deo Optimo Maximo*), the very ancient dedicatory letters over the entrance to a church, commending it "To God, all-good, all-powerful." The ancient sarcophagi in the "Aliscamps" (*Elysii campi*) or Roman burying-ground, at Arles in Southern France, as the observant traveller may to this day remark, have many of them been neatly converted from pagan use to Christian, after the ashes of the ancient occupant were dislodged, by sculpturing a letter O between the D. M. which dedicated the tomb to the *Diis Manibus* (Funeral gods), so that the Roman D. M. became the orthodox and familiar Christian D. O. M.

The prefixed title of the Portuguese king and nobles still remains *dom*, as that of the Spanish king and nobles is *don*, each having a larger meaning than our "lord."

DOM-DANIEL it is necessary to define if only for the allusion in the beginning of that magnificent prose-epic, Carlyle's "French Revolution." "And so have these individuals (the ministers of Louis XV. in his old age), verily by Black Art, built them a *Dom-daniel* or enchanted Dubarrydom, where they dwell pleasantly, Chancellor Maupeon playing blindman's buff with the scarlet enchantress, or gallantly presenting her with dwarf negroes," &c. The word is corrupted from a mediæval Eastern source, the later "Arabian Nights," and is the title of the submarine enchanted palace of the evil spirits and genii near Babylon. Carlyle selected the now almost obsolete word as a fit designation of the abode of "Dubarrydom," in every respect the opposite of "Christendom." It is not unfrequently found in our older writers.

DOME, a term applied to a covering of the whole or part of a building. The word *dome* is strictly applied to the external part of the spherical or polygonal roof, and *cupola* to the internal part.

The most magnificent dome of antiquity is that of the Pantheon, which is supposed to have been a chamber of the great baths of Agrippa. Internally it is divided into five rows of square compartments, which are supposed to have been decorated with plates of silver. The external part of the dome appears also to have been decorated with bands of bronze. The base of the dome externally consists of a large plinth, with six smaller plinths or steps above it; and in the curve of the dome a flight of steps is formed which leads to the opening at the top. The dome is constructed of bricks and rubble. The thickness is about 17 feet at the base, 5 feet 1½ inch at the top of the highest step, and 4 feet 7 inches at the top of the dome. The circular wall which supports the dome is 20 feet thick.

Of other ancient structures of this kind whose ruins exist we may mention the Thermæ or Baths of Caracalla, Titus, Constantine, and Diocletian, all surmounted by domes. Near Pozzuoli there is a very perfect circular building, with a dome 96 feet in diameter, built of volcanic tufa and pumice stone. The temple of Minerva Medica, without the walls of Rome, had a dome of ten sides built of brick and pumice stone.

The dome of Santa Sophia at Constantinople, built in the reign of Justinian, rests on the square formed at the intersection of the arms of a Greek cross. The dome is supported by four corbellings placed in the angles of the square, surmounted by a kind of cornice which supports a circular gallery. Externally the dome is divided by projecting ribs, rounded and covered with lead. The top is surmounted by a lantern or finishing like a baluster, on which is a cross. (See Plate Basilica.) The dome of San Vitale at Ravenna is curiously constructed. The lower part is a regular octagon, supported by eight piers placed at the angles of the dome; in the spaces between the piers are seven niches, divided into two storeys. The wall above the niches sustains a hemispherical dome, the plan being a circle described within a regular octagon. The dome is built with a double row of pipes, hollow at one end and pointed at the other, the point of one bein g placed in the hollow of the preceding. The dome is covered with mortar both within and without. St. Mark's, at Venice, built in the tenth century, is decorated with five domes. One of these, placed in the centre of the church, is much larger than the others. Each dome is inclosed within four pieces of semi-cylindrical vaulting, forming together a square, in the angles of which are four corbels, which gather in the circular base of each dome. The dome of Santa Maria del Fiore, the cathedral of Florence, built by Brunelleschi, stands upon an octagon tower 175 feet high. The dome is double, being the first of the kind that is known. The internal dome is connected only at the angles to the external one, and forms a species of Gothic vault. The first modern dome constructed in Rome was that of Our Lady of Loreto, built in 1507; it is double and circular in plan, and is constructed on double consoles.

The dome of St. Peter's at Rome, as planned by Michael Angelo, and executed by himself and succeeding architects, is thus constructed:—It stands upon four piers 62 feet high. From the arches spring corbellings, which are finished by an entablature; upon this is a plinth, octagonal within and circular without; upon this is a circular stylobate 12 feet high. Above the stylobate is the drum of the dome, built of rubble and fragments of brick, and pierced by sixteen lofty windows: the height of the drum is about 52 feet. On this is placed a circular attic storey, 19 feet high, and then comes the double dome. The space between the two domes varies from 3 to 10 feet in width. The thickness of the inner dome is about 6 feet, the outer of less thickness, and the two are joined together by sixteen strong walls or spurs. Above the dome are a lofty lantern and cross. The dome is about 102 feet high above the drum, and the lantern and cross 90 feet above the dome.

The dome of St. Paul's Cathedral, London, is placed over the intersection of the four naves. The ground-plan is a regular octagon; four of the sides are formed by the four great arches of the naves, the other four sides are formed by false arches of the same size. The corbellings gather in a circle, and are surmounted by a complete entablature decorated with consoles. The drum, which surmounts the entablature, is 62 feet in height; and from the summit of this rises the double dome. The inner dome is much less lofty than the outer; the outer one is constructed of wood, covered with lead. Between the two is the true roof of the dome-space, a steep cone. The amount of space lost by this construction lessens the grandeur of the interior. (See Plate V. English Cathedral Architecture.)

The dome of the Church of the Invalides at Paris is raised on the centre of a Greek cross, on an octagonal base with four large and four small sides. A circular entablature is placed over the corbellings, and on the entablature is raised the drum of the dome. The dome, which is double, rises from a springing common to both. The lower or internal dome, constructed with masonry, is spherical; whereas the outer dome is of a spheroidal form, and constructed of stone at the base and of brick above. The dome of the Pantheon at Paris is constructed entirely of stone, and is placed in the centre of a Greek cross. It is supported by four triangular piers, pierced above with arched openings, and between the piers with the openings are large arches. Between these arches rise the corbellings, which are gathered in to form the circular plan of the drum. The arches and the corbellings are crowned with a large entablature about 18 feet high, and above this is the circular drum, 55 feet high. There are three domes, one within another; one forming the interior vault or roof, a second forming the exterior, and a third shaped like the small end of an egg, and intermediate between the other two, for supporting the lantern. This construction admits of a larger internal dome than that of St. Paul's.

The following are the measurements of most of the principal domes of Europe:—

	Feet in diameter externally.		Ft. high from the ground line.
Dome of the Pantheon, Rome, . .	142	...	143
" Minerva Medica, do., .	78	...	97
" Baths of Caracalla, do.,	112	...	116
" Baths of Diocletian, do.,	74	...	83
Temple of Mercury, do., ...	68	...	—
" Diana, do., ...	98	...	78
" Apollo, do., ...	120	...	—
" Proserpine and Venus, .	87	...	77
Santa Sophia at Constantinople, .	115	...	201
Mosque of Ahmed, do., ...	92	...	120
San Vitale at Ravenna, ...	55	...	91
San Marco at Venice, ...	44	...	—
Santa Maria del Fiore, Florence, .	139	...	310
The Chapel of the Medici, do., . .	91	...	199
Baptistry at Florence, ...	86	...	110
St. Peter's at Rome, ...	139	...	330
Church of the Madonna at Venice, .	70	...	133
" Superga at Turin, .	64	...	128
" Invalides at Paris, .	80	...	173
" Val de Grace, do., .	55	...	133
" Sorbonne, do., . .	40	...	110
Pantheon, Paris, ...	67	...	190
St. Paul's, London, ...	112	...	215
Reading-room of British Museum, .	140	...	106

The dome of the British Museum is noticed in the article British Museum.

DOMENICHI'NO. *Domenico Zampieri*, who was commonly called Domenichino, was born at Bologna in the year 1581, of poor parents. He studied chiefly under the Caracci, by whom he was highly appreciated. He visited Parma, and then settled for a time in Rome, where, having also studied architecture, he was appointed architect to the apostolic palace by Gregory XV. After the death of that pontiff he removed to Naples with his wife and children. He died in 1641.

Domenichino was profoundly studious in his drawing, rich and natural in his colouring, and, above all, correct and lifelike in his expression. To the graver design of the Bolognese school Domenichino added something of the ornamental manner of the Venetian, his pictures being rich in the accessories of architecture and costume. His genius, however, is not characterized by great invention. He has been accused of borrowing too directly from the works

of others (frequently he imitates Raphael's manner very closely and successfully), and his draperies have been confessed by his admirers to be harsh and too scanty in the folds. He is to be considered among the greatest painters of the eclectic period, or period of the decline of art.

Domenichino excelled also in landscape. His principal works are at Rome and Naples. Among them the "Communion of St. Jerome" and the "Martyrdom of St. Agnes" are the most celebrated. Our National Gallery has some fine examples of Domenichino, particularly "St. Jerome with the Angels" and the "Stoning of St. Stephen."

DOMESDAY BOOK, the register of the lands of England framed by order of King William the Conqueror, in 1081–86. It was sometimes termed *Rotulus Wintoniæ*, and was the book from which judgment was to be given upon the value, tenures, and services of the lands therein described. In the year 1085 serious apprehensions appear to have been entertained of an invasion of the kingdom by the Danes, and the difficulty which the king then experienced in putting the country into a satisfactory state of defence led him to form the notion of having a general survey made of the whole kingdom, in order, as Sir Martin Wright observes, "to discover the quantity of every man's fee, and to fix his homage," or, in other words, to ascertain the quantity of land held by each person, and the quota of military aid which he was bound to furnish in proportion to the extent of his holding. From the contents of the book itself, however, the main object of the survey was to show the king to whom and in what proportions the country was allotted, to guard small landholders against the encroachments of the great proprietors, and in general to facilitate administrative, legislative, and fiscal measures.

The book shows the name of each estate, the name of its owner in Edward's reign and then in the reign of William (that of Harold being studiously omitted), its extent and the number and size of its woods, pastures, ponds, &c., the number of freemen and villeins upon it, and its total value—the particulars being given for each separate county as ascertained by commissioners from information which was rendered on oath by the chief laymen and churchmen in each district.

The original Domesday Book is comprised in two volumes, one a large folio, the other a quarto. The first is written on 382 double pages of vellum, all in one handwriting, in a small but plain character, each page having a double column; it contains thirty-one counties. The second volume is written upon 450 double pages of vellum, but in single column and in a large fair character, and contains the counties of Essex, Norfolk, and Suffolk.

These two volumes are preserved, among other records of the exchequer, in the Chapter House at Westminster; and at the end of the second is the following memorial, in capital letters, of the time of its completion:—"Anno Millesimo Octogesimo Sexto ab Incarnatione Domini, vigesimo vero regni Willielmi, facta est ista Descriptio, non solum per hos tres Comitatus, sed etiam per alios." From internal evidence there can be no doubt but that the same year, 1086, is assignable as the date of the completion of the first volume.

The order generally observed in writing the survey was to set down, in the first place, at the head of every county (except Chester and Rutland) the king's name, *Rex Willielmus*, and then a list of bishops, religious houses, churches, any great men, according to their rank, who held of the king *in capite* in that county, likewise of his thegns, ministers, and servants; with a numerical figure in red ink before them, for the better finding them in the book. The king's demesnes, under the title of *Terra Regis*, always stand first.

Freeman ("Norman Conquest," vol. v.) observes that "never was there a dry legal record so full of human interest of every kind as the great survey of England," and the book has undoubtedly much historical value as a minute and thoroughly faithful picture of England before and immediately after the Norman Conquest. It is indeed something more than a "dry legal record," for many details are given which throw light on the manner of the confiscation of English estates, on the division of the country into shires, &c., on the different condition of various districts, and also on the character of William. It is marked by an air of consistent impartiality in its statements of the rival claims of Englishmen and Normans, King William himself being in one place included among those wrongfully holding the lands of others.

A photozincographic facsimile of the entire work was published in 1863, by order of her Majesty, under the direction of the Ordnance Survey. This work is sold in parts relating to each county, and translations with the text, *in extenso*, of several of the counties have been published by Vacher and others as supplements to the facsimile.

Taxation was assessed according to the Domesday Book of William until 1552, when a new survey was made. From the time of the Conqueror, however, nearly 800 years elapsed before any survey for Great Britain and Ireland was made approximating in extent to that of England in 1081–86. The census returns of 1861 gave only 30,000 persons as owners of land, and the conclusion at once drawn by many people was that the land was monopolized by a jealous territorial aristocracy—a mere handful in comparison with the millions of the people—and that this exclusive caste ingeniously baffled the desire of the rest of their countrymen for a share in the soil with the aid of a complicated and costly land law. That the nature of the land laws favoured the accumulation of large estates it was impossible to deny, but it was doubted whether this had become the actual fact so far as to have parcelled out the whole country between 30,000 persons. In deference to very general desire, steps were taken by the government in 1872 to ascertain the real character of the division of the land, and the result of a very careful and laborious inquiry, published as a parliamentary return in 1876, has since been popularly known as "The New Domesday Book." This return shows that, instead of 30,000 only, there were no less than 1,173,683 persons owning land in the United Kingdom, of whom 321,245 were proprietors of 1 acre and upwards. The holdings of those with less than an acre are represented chiefly by the garden ground attached to house property; and although French and Flemish peasants are said to work economical wonders with small plots, holders of less than an acre in the United Kingdom can scarcely be regarded as a proprietary that lives by possession. We give some analysis of "The New Domesday Book" as presenting a valuable reflex of the state of land proprietorship in this country.

The respective returns show the area, and we reproduce the figures so that our readers will be able to see the relation they bear to the number of landowners. The extent of the assessable land in the United Kingdom, exclusive of the metropolis, as shown in the returns, is 72,117,766 acres: England, 33,013,515; Scotland, 18,946,694; and Ireland, 20,157,557.

The total number of landowners in the United Kingdom, exclusive of the metropolis, is as under:—

	Number of Owners of less than one acre.	Number of Owners of one acre and upwards.	Total Number of Owners.
England, . .	703,289 ...	269,547 ...	972,836
Scotland, . .	113,005 ...	19,126 ...	132,131
Ireland, . . .	36,144 ...	32,572 ...	68,716
United Kingdom,	852,438	321,245 ...	1,173,683

The rental of such landowners is:—

England, ...	£99,352,301
Scotland, ...	18,698,774
Ireland, ...	13,417,758
United Kingdom, ...	£131,468,833

With regard to England, the twelve largest owners hold in the aggregate 1,058,883 acres; and their respective acreages are 186,899, 133,001, 102,789, 91,024, 87,515, 78,542, 70,022, 68,066, 66,105, 61,018, 57,802, and 56,600. The aggregate of the twelve largest owners in Scotland is 4,339,722 acres; and their respective acreages are 1,326,453, 432,369, 424,560, 372,729, 305,891, 302,288, 253,221, 220,663, 194,640, 175,114, 166,151, and 165,648. The twelve largest owners in Ireland hold 1,297,888 acres; and their respective acreages are 170,119, 156,974, 121,353, 118,607, 114,881, 101,030, 95,008, 94,551, 93,629, 86,321, 72,915, and 69,501. In the United Kingdom the twelve largest owners hold 4,440,467 acres, and their respective acreages are 1,358,548, 459,183, 424,560, 372,729, 319,400, 305,891, 253,221, 220,663, 194,640, 186,399, 175,114, and 170,119.

It will be observed from the foregoing figures that the largest landowner in Scotland holds 1,326,453 acres. The same owner holds in England 32,095 acres, which, added to the other amount, makes 1,358,548 acres. The acreage of this one landowner is more than the sum of the estates of the twelve largest landowners in England, the extent of their holdings being only 1,058,883 acres; or of the estates of the twelve largest owners in Ireland, which amount to 1,297,888 acres. It will be further noticed that the extent of land of the twelve largest owners in Scotland is 4,440,467 acres, or about one-fourth of the land of that kingdom. This amount is four times the area of the twelve largest owners in England. It is equal to the area of eight English counties—viz. Bedfordshire, Berkshire, Buckinghamshire, Cambridgeshire, Cheshire, Cornwall, Cumberland, and Derbyshire, and larger than the whole of North and South Wales.

The division of owners into classes, according to their acreage, shows results which are rather striking. Classification generally brings out inequality, which shows itself in different ways, and we direct special attention to the following figures.

In England the average extent of land held by each owner is 33 acres 3 roods 30 poles; in Scotland it is 143 acres 1 rood 6 poles; and in Ireland it is 293 acres 0 rood 32 poles. In England the average estimated rental of each owner is £102 3*s*., in Scotland it is £141 8*s*., and in Ireland the acreage rateable value of each owner is £195 3*s*.

In England 72·3 per cent. of the owners hold property below an acre each; in Scotland 85·5, and in Ireland 52·6. In England the proportion of the class of owners holding from 100 to 500 acres to the total number of owners, exclusive of those below an acre, is 90 per cent., in Scotland 80, and in Ireland 60.

Two-thirds of the land in England are held by 10,207 landowners; two-thirds of Scotland by 330 landowners; and two-thirds of Ireland by 1942 landowners. The other one-third of the land in England is held by 962,629 owners; by 131,801 owners in Scotland; and by 66,774 owners in Ireland.

There is a striking contrast between the size of the estates of the three kingdoms as well as in the amounts of rentals. The Scotch holdings are generally larger than the English or Irish. A large amount of land, however, in Scotland is mountain or moor land, hence it will not be proper to lay the same stress on the size of the holdings as in England. The Irish estates comprise a larger area than the English, but are below the Scotch. Comparing the estates of the twelve largest landowners in the three kingdoms respectively, we find that the twelve largest proprietors in Scotland hold in the aggregate 4,339,722 acres; the twelve largest in Ireland, 1,297,888 acres; and the twelve largest in England, 1,058,883 acres. The range of the Scotch estates is from 165,648 acres, the lowest, to 1,326,453 acres, the highest; the Irish from 69,501 acres to 170,119 acres; and the English from 56,600 to 186,399 acres. The average amount of rental of these estates is 3*s*. 2*d*. per acre in Scotland, 5*s*. 8*d*. in Ireland, and 22*s*. 6*d*. in England. Taking a single owner in each country, the largest proprietor in Scotland is in the possession of land amounting in the whole to 1,326,453 acres, from which he receives a rental of £68,398, or a little more than 12½*d*. per acre. The largest owner in Ireland holds 170,119 acres, with a rental of £8743, or 12¼*d*. per acre; while the largest owner in England owns 186,399 acres, with a rental of £176,049, or about 19*s*. per acre. Passing from these facts, and looking at the matter in relation to the population and inhabited houses respectively, the contrasts between the returns of the three kingdoms are great. In England there is one owner of land to every twenty of the population, one in twenty-five in Scotland, and one in seventy-nine in Ireland. But if we exclude the owners below an acre, and take those of one acre and upwards only, the proportions are respectively one in seventy-two, one in 176, and one in 166. As regards the proportion of owners of land to the inhabited houses, it is one in four in England, one in three in Scotland, and one in fourteen in Ireland.

DOM'ICILE (Lat. *domicilium*), in the Roman law, was defined to be that place which a person "makes his family residence and principal place of business; from which he does not depart unless some business requires: when he leaves it he considers himself a wanderer, and when he returns to it he deems himself no longer abroad." ("Code of Justinian," &c.)

The constitution of domicile depends on the concurrence of two elements—1st, residence in a place; and 2nd, the intention of the party to make that place his home. Residence is generally, though not always, a fact of a simple kind; but the intention of the party must often be deduced from many circumstances.

The following rules appear to comprise the generally adopted principles on the subject:—

1. The domicile of the parents is the domicile of the child. This is generally called the domicile of origin, and is often the same with the place of birth, unless the parent should change his domicile during the child's minority. An illegitimate child follows the domicile of his mother.

2. Minors are generally considered incapable of changing, by their own act, the domicile of origin during their minority. If the father change his domicile, that of the children follows it; and if he dies, his last domicile will be that of his infant children.

3. A married woman follows the domicile of her husband.

4. A widow retains the domicile of her late husband till she acquires another.

5. The domicile of origin must be considered to prevail till the party has not only acquired another, but manifested and carried into effect an intention of abandoning his former domicile and abiding by another as his sole domicile.

6. An acquired domicile is not lost by mere abandonment, but continues until a subsequent domicile is acquired, which can be done only by residence and intention.

7. A married man's domicile is generally to be taken to be where the residence of his family is.

8. If a man, whether married or not, has two places of residence at different times of the year, that will be esteemed his domicile which he himself selects, describes, or deems to be his home, or which appears to be the centre

of his affairs—that of a nobleman or country gentleman, his residence in the country; that of a merchant, his residence in town.

9. Residence in a place to produce a change of domicile must be voluntary. Also, a person abroad in the service of the state does not change his domicile.

Thus it appears that domicile is of three kinds—1st, domicile of origin, depending on that of the parents at the time of birth; 2nd, domicile of choice, which is voluntarily acquired by the party; and 3rd, domicile by operation of law, as that of a wife arising from marriage.

The determination of a person's domicile is often a question of great practical importance.

When a man dies intestate his personal property must be distributed according to the law of the country in which he was domiciled at the time of his death. Wills made out of the kingdom by British subjects are valid if executed according to the laws of the place of domicile; but no British subject dying in a foreign country is held to have acquired a domicile, unless he has been resident there for one year, and has deposited in a public office of the foreign country a written declaration of his intention to become domiciled there. In England every person, whether native or foreigner, who is for the time being within England, is amenable to the jurisdiction of its civil courts, and may sue or be sued in them. In Scotland the same rules apply generally. But in addition a person domiciled abroad, who has heritable property in Scotland, may for certain purposes be proceeded against in the Scottish courts; where his property is only movable an attachment of the property is necessary, and this is termed *arrestment jurisdictionis fundandæ causâ*. But actions of personal status, as fo divorce, establishing a marriage, &c., can only proceed when the parties have established a domicile there by residence for forty days. The Scottish poor law requires a residence of five years in a parish before domicile can be pleaded by a pauper.

DOM'INANT, in music, is the name given to the fifth degree of the scale, from the great power of chords in that degree (and their inversions) to fix and determine the key. The diatonic chords of the tonic and the subdominant, the two other chief chords of the key, may belong to more than one key, but the chord of the dominant Seventh is proper to its own key, and can belong to no other. It resolves upon the tonic chord, and the conjunction of the two, the "perfect cadence" (see CADENCE), is the firmest musical combination known, giving a sense of completeness and finality not obtainable by any other means. Thus the dominant Seventh in the key of C is the diatonic chord of the Seventh upon G as a root—namely, G B D F. But B being natural the chord cannot be in F or any other key with flats, since in them B♭ is always necessary. So also F being no note of the keys of G, D, A, and other "sharp" keys, all of which have F♯, shows that the chord is in no "sharp" key—and it has been proved to be in no "flat" key; it must therefore be in C. As has been said in the article DISCORDS (FUNDAMENTAL), all dominant discords (and no other diatonic discords whatever) follow the same series of intervals—viz. the dominant, its major Third, perfect Fifth, minor Seventh, major or minor Ninth, perfect Eleventh, and major or minor Thirteenth. Taking such a chord of the Seventh from E as a root, we find the notes of the above qualities would be E, G♯, B, D. In what key is this a dominant? It is not in C, because o the G♯; nor in F nor any flat key, because of the B♮. I is not in G nor D, because of the G♯; it may be in A (wher G♯ is the Seventh of the key); and it cannot be in E, because of the D♮. It is therefore in A, and in A alone.

For these reasons the dominant is held second only to the key-note in importance. In FUGUE the subject, given out in the key of the piece, is always repeated in the dominant; and the scale is considered to be divided int "halves," the tonic taking five notes up to the dominant, the dominant four notes up to the tonic, as their respective parts. So also in all old-fashioned works and in most of the best planned works of the present time, the second subjects of important movements are taken in the dominant. Any other arrangement weakens the impression of the key. The major key, however, serves as the dominant in this respect to pieces in the relative minor.

DOM'INIC, ST., the reputed author of the terrible INQUISITION, and founder of the famous order of Dominican friars, was born in 1170 at Calahorra, a village of Old Castile in Spain. His Spanish name was Domingo de Guzman, and his family was noble. Legends, probably aftergrowths, cluster about his birth and infancy. His mother dreamed she bore a dog with a torch in his mouth which set the world on fire. As a boy he crept from his bed to lie on the hard ground; he sold his clothes to feed the poor; he offered to sell himself as a slave to the Moors (at this time masters of the fairest province of Spain) to redeem the brother of a lady. At this time the life of every devout Catholic was a perpetual crusade against Jew and Mohammedan. The church was asleep, lulled in splendour and riches, while the people starved for religious teaching. The best of the Benedictines and the other elder orders had retired into hermitages, where some selfishly strove for their own salvation, while others lived in idleness and luxury. Heresy, or what was so called, undertook to satisfy the people's longings, for the church had failed in her mission. It is not surprising that in this manifest need men appeared, born of the world's wants, to meet the necessities of mankind. Dominicus (as Domingo de Guzman called himself) in Spain, and Franciscus (St. Francis of Assisi) in Italy arose almost together, and worked on nearly the same plan. They identified themselves with the poor, they preached to and lived with the ordinary labourers, and thus while sharing the austerity of the hermits they elevated the ignorant souls around them, and combated the heresy which began to raise its head. They invaded the universities and boldly put down the innovating professors, and they sent missionaries among the heathen. Looking back we can see that it was a conservative reaction, an attempt, wonderfully pure and zealous, to turn the church back to primitive simplicity, and so successful that it held off the Reformation for three centuries.

From fifteen to twenty-five Dominic had been a student at Palencia University, whence he went to the Cloister of Osma, where the conventual rule was the most austere in Spain. He accompanied the Bishop of Osma to Denmark on a state mission, and when passing through France was grieved at the progress the Albigensian heresy had made in Languedoc. Returning again through France from Denmark, Dominic was bold enough to upbraid the Papal legates, whom he met retreating to Rome quite worsted in their conflict with the new heresy, and to show them that "it is not by the display of power and pomp, cavalcades of retainers and richly houseled palfreys, or by gorgeous apparel that the heretics win proselytes. Zeal must be met by zeal, humility by humility, false sanctity by real sanctity, preaching falsehood by preaching truth." Even the legates were ashamed, and reduced their equipages; some say they went barefoot. But as for Dominic his whole life was turned. He adopted to the full the course he had recommended. His preaching was irresistible. He performed, so it is now said, miracle after miracle, accounts of which may be read in the "Acta Sanctorum." Then came the crusade against the heretics of Southern France under Simon de Montfort, and Dominic is believed to have taken part in the conflict—to have marched cross in hand in the van of the army. With the gloomy religious fervour of Spain he presided over the tribunals for judging De Montfort's unhappy prisoners, and delivered them over to

the "secular arm" for burning at the stake by hundreds. Thus began the Inquisition, tradition justly referring its spirit to Dominic, though rigid inquiry fails to trace back to him the actual formulating of that horror of the world. Dominic would *compel* men, Francis *won* them to the faith.

Dominic went to Rome in 1218 to gain permission to found his proposed order of preaching friars. Innocent III. at first refused, grounding his refusal on the authority of the third Lateran Council's prohibition of new orders; eventually, however, a reluctant consent was extorted. He saw a vision, it is said, ordering him to revise his former refusal. Four years latter (1217) Dominic founded the monastery of San Sisto at Rome, and later that of Santa Sabina, both on the Cœlian Hill. Preachers were enrolled and sent abroad with amazing rapidity. The fire of Dominic was irresistible, and overcame all opposition. He and his followers, many of them of noble birth, lived on alms, dressed in a rough white woollen under-robe covered with a cowled black robe, and dwelt in the most wretched cells. The pope Honorius III. yielded to the power of the general of the new order, and named him Master of the Sacred Palace, an office ever since held by the general of the Dominicans. But the Franciscans, who had been founded in 1210, were increasing as rapidly as the Dominicans, and Dominic was far-sighted enough to see that their more rigid poverty would assuredly be held holier than his own rule, which allowed the order to accumulate wealth though each friar was a mendicant. Accordingly in all honourable emulation (for the founders of the two orders had met, and each time with many marks of reverence and esteem for each other). Dominic called a chapter in 1220, and rigorous poverty was enjoined by the unanimous vote. At a second chapter in 1221 the order was divided into eight provinces —Spain, Provence, France, Lombardy, Rome, Germany, Hungary, and England. In England Stephen Langton welcomed the Dominican Gilbert, and at once licensed him to preach throughout the land; monasteries of Black Friars arose at Canterbury, London, and Oxford. Both Franciscans and Dominicans had nuns as well as friars; and both had also *tertiaries*, or lay associates. The latter idea was afterwards more fully worked out by the Jesuits, between whom and the Dominicans dire hatred sprang up almost with the very birth of the youngest of the orders—itself founded by a countryman of Dominic, the Spaniard Loyola—and continues to this day. Each Dominican prior had his faithful crowd of tertiaries, whom he called "soldiers of Jesus Christ," and through them he exerted a wide and subtle influence among the people.

Dominic died at Bologna in 1221, soon after the second chapter, and in 1233 the general demand for his canonization was agreed to by Gregory IX., who had, as the Cardinal Ugolino, been one of his warmest friends. The Franciscans are often charged with idolatry of St. Francis, but truly the Dominicans are not far behind them. Gregory, in canonizing him, said he was as much a saint as St. Peter and St. Paul; later popes decreed that he was the adopted son of the blessed Virgin, and painters represented the skirts of the Virgin's robe as covering the order; preachers compared the brethren of St. Dominic to the apostles; and the extraordinary parallel is carried to what appears an awful length in the "Acta Sanctorum." [See BOLLANDISTS.] The father is addressing Mary:—"Ego, dulcissima filia, istos duos filios genui; unum naturaliter generando, alium amabiliter et dulciter adoptando Sicut Filius in omnibus fuit perfectissime obediens mihi, usque ad mortem, sic filius meus adoptivus Dominicus," &c. Here Jesus is spoken of as the natural, Dominic as the adopted, son of God. And this is the authoritative Catholic work on the lives of the saints! In fifty years after St. Dominic's death there were 470 monasteries of Dominican Friars, and in the eighteenth century there were 1000. At present the order is rapidly dwindling away. In its palmy days it boasted Albertus Magnus (the Universal Doctor) and St. Thomas Aquinas (the Angelic Doctor) among its members. The works of the latter are considered by the present pope (Leo XIII.) to embody perfectly the church's philosophical and theological views. The papal censor of books is always the Master of the Sacred Palace, and this, as said above, is an office of the Dominicans [see INDEX, CONGREGATION OF THE], and the INQUISITION has also always been under their guidance. In England they were called Black Friars (the Franciscans being the Grey Friars), and in France Jacobins, as their first convent was in the Via Jacobi (Rue St. Jacques). The famous Jacobin Club of the Revolution got its name from meeting in the refectory of an old Dominican convent. An excellent account of St. Dominic and the early Dominicans is given in Milman's "Latin Christianity" (vol. vi., 4th edition, 1883).

DOMINI'CA, the largest island of the Leeward group of the Lesser Antilles, lies between the French islands of Martinique and Guadaloupe; the parallel of 15° 18′ N. lat. and the meridian of 61° 28′ W. lon. pass through the island. It is 28 miles long and 16 broad at the widest part, but its mean breadth is not more than 9. The area is 291 square miles. The population, according to the census taken in 1881, was 22,211. The surface is mountainous; Morne Diablotin, the highest summit, is 5130 feet above the sea. The valleys are very fertile, and well watered. In the centre of the island is an exceedingly deep "boiling lake." The temperature is from 180° to 195°. The ebullition of the water is usually from 2 to 3 feet, but it occasionally rises a foot or more higher. A volcanic explosion took place at this lake in 1880, which laid waste an area of fully 9 square miles, while the mouth of the lake, which had previously been 300 feet across, was left only about 15 feet wide. Fresh-water and sea fish are very plentiful. The chief products are coffee, sugar, rum, and cocoa. The principal town, Roseau, stands on a tongue of land on the south-west side of the island. Prince Rupert's Bay, on the north-west side, is at all times safe and commodious. The annual revenue and expenditure of the island is each about £15,000, and the value of the exports and imports each average over £60,000 yearly. The chief trade is with Barbadoes, British goods being in a great degree imported thence. The coffee of Dominica is considered among the best in the West Indies. The soil is also peculiarly favourable to the cultivation of cocoa, but the produce is not equal to that of Trinidad. The great body of the population of Dominica is Roman Catholic, and there is a bishop of Roseau.

Though sending representatives to the central legislative council, Dominica has still a local government, administered by a president, who is aided by an executive council and a legislative assembly of fourteen members.

Dominica was discovered by Columbus on Sunday (*Dies Dominica*), 3rd November, 1493, from whence it derives its name. This island was included in the patent of 1627, whereby sundry of this group were granted to the Earl of Carlisle; but the French having already colonized it, it continued in their possession—or, more properly speaking, in the possession of its original owners, the Caribs, who suffered the French to establish themselves on its shores. In 1756 it became, by conquest, a dependency of Great Britain, and by the treaty of peace signed at Paris in 1763 it was confirmed to this country.

The native Caribs, a brave and warlike race, gave much trouble, and were transported in a body to Honduras in 1776. Two years later the island was again captured by the French, but in 1783 it was restored to the British, who resisted another French attempt in 1795. It became finally secured to England in 1814. In its neighbourhood Rodney inflicted his great defeat on the Count de Grasse in 1782.

DOMIN'ICAL LETTER (*Dies Dominica*, Sunday). To every day in the year is attached one of the first seven

letters, A, B, C, D, E, F, G; viz. A to the first of January, B to the second, &c.; A again to the eighth of January, and so on. The consequence is, that all days which have the same letter fall on the same day of the week. The *dominical letter* for any year is the letter on which all the Sundays fall. In a common year the first and last days have the same letters, whence the dominical letter of the succeeding year is one earlier in the list. But in the leap-year it is to be remembered that the 29th of February has no letter attached to it; whence every leap-year has two dominical letters, the first for January and February, the second for all the rest of the year, the second being one earlier than the first.

As it is convenient in historical reading to be able to find the day of the week on which a given day in a distant year fell, we subjoin the following rules for finding the dominical letter.

Old Style.—Add to the given year the quotient of its division by four, and then add four: find the remainder of the whole sum when divided by seven. The dominical letter (the second letter, if it be leap-year) is written under that remainder in the following table:—

6	5	4	3	2	1	0
A	B	C	D	E	F	G

New Style.—Add one more than the given year to the quotient of the division of the given year divided by 4, and if the date is beyond 1600 divide the excess of the number of the century over 16 by 4, and add the quotient, omitting remainders; then subtract that excess from the whole sum. Divide the result by 7, and the remainder shows the dominical letter as before.

The following are examples:—

O. S.	N. S.	N. S.
1032	1848	4610
1032	1849	4611
258	462	1152
4	0	7
7)1294	2311	770
Rem. 6		80
2nd Letter A		
	7)2509	7)5740
	Rem. 6	Rem. 0
	2nd Letter A	Letter G

DOMIN'ICANS, an order of mendicant friars in the Roman Catholic Church, founded in 1215 by St. Dominic. They thus receive this name from their founder. They were called Preaching Friars from their office to preach and convert; Black Friars, from the colour of their outer garment; and in France Jacobins, from having had their first house in the Rue St. Jacques at Paris. At present the order flourishes only in Italy, France, and one or two other places. There are also Dominican Nuns, who are not, however, numerous. See DOMINIC, ST.

DOM'INO, the name given to the costume worn at a masquerade, usually consisting of a large mantel or cloak with wide sleeves. It formerly signified the dress worn in winter by priests officiating in cold edifices.

DOM'INOES, the name given to small flat pieces of ivory or bone, used to play the game so called. Each domino is divided by a line across its face, and on each half, except the "blanks," are marked numbers, in small black dots, ranging from one to six. The game is usually commenced by the player who has the highest "double" number, and the rest follow in order, each being bound to play a domino containing a number similar to the "open" half of the one immediately preceding it; or if the last "open" half be a blank, he must follow with a blank. Thus double-blank must be followed by a blank. Let this be blank-three; this must be followed by a three. Let this be three-six; this must be followed by a six, &c. If the next player cannot follow he loses his turn. Usually the interest of the game is increased by several dominoes being left undistributed, so that the complete set is not in play. The usual complete set numbers twenty-eight pieces, no two being alike. (A not very usual form of the game runs up to nine dots instead of six; the number of dominoes in such a set is fifty-five.) The party wins who has first played out (*i.e* disposed of all his pieces); or if this is found to be impossible, the one who has the least number of dots on his remaining dominoes is considered the victor. The game is of considerable antiquity, and is played very generally in Germany and France.

DOM'INUS, now recognized as the Latin equivalent for Lord (so that the mass says *Dominus Deus Sabaoth* for "Lord God of Sabaoth," and old law Latin has *dominus rex* for "our lord the king"), simply meant originally a master of slaves. The early Roman emperors refused the title of king, preferred that of "prince of the senate" (*princeps*—*i.e.* first or president—*senatus*), and tolerated rather than adopted the military title *imperator* (emperor), which meant "commander-in-chief." Domitian, however, the last, and taken altogether the worst, of the twelve Cæsars, was not content with being prince or general, nor even with the deification after death always accorded to the emperor; he adopted the awful title of *Dominus et Deus noster* ("our Lord and God!"), claiming to be divine during life, and as such to be worshipped as a god, while politically his worshippers were regarded as his slaves (*servi*), and he as their slave-owner or master (*dominus*). Hence dominus gradually lost the sense of slave-owner, and took on a princely signification, finally becoming a title of distinction, "lord." Pliny, though he protests against slave-owner (*dominus*) being used as a title, himself employs it in addressing his imperial friend Trajan.

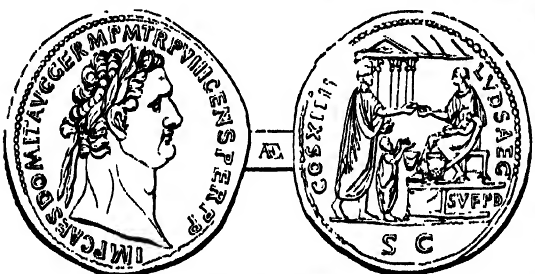
In the middle ages *Ds.*, contraction for dominus, is found prefixed to names on tombstones, in records, &c., with tolerable frequency. In this case it means that the person is a clergyman or a knight; rarely it extends also to a lord of the manor. The use of lord for the inferior clergy seems odd in our day; but it is curious to notice that in Holland at the present time the ministers of the Reformed Church still bear this same title, although it has so completely died out among ourselves. See also DOM.

DOM'ITE, a variety of TRACHYTE containing from 62 to 68 per cent. of silica (an unusually high amount), probably in part as tridymite. It gets its name from its occurring in the Puy de Dome (in Auvergne), where several of the so-called "puys" (dome-shaped hills of volcanic origin) consist mainly of this rock.

DOMI'TIAN, Emperor of Rome. Titus Flavius Domitianus Augustus Cæsar, born A.D. 51, was the youngest son of the Emperor Vespasian, and succeeded his brother Titus as emperor in 81. Tacitus gives an unfavourable account of his youth. His father at first proclaimed him a Cæsar (*i.e.* vice-emperor) as well as his brother Titus. Domitian, however, proved so arbitrary and capricious, and so dissolute, that the good emperor made him pass into retirement during the remainder of his reign, a policy which Titus also followed when he assumed the purple. Domitian lived very disgracefully, though like Nero he cultivated poetry and composition. He was always suspected of causing the death of Titus. In the beginning of his reign he affected great zeal for religion and the reformation of public morals. His awful assumption of divinity has been described under DOMINUS. He forbade, under severe penalties, the practice of emasculation. He completed several splendid buildings begun by Titus, among others an Odeum, or theatre for musical performances.

Domitian's character soon deteriorated, through the temptation of practically unlimited power, into a compound of avarice and cruelty. He either put to death or

drove away from Rome the philosophers and men of letters: the slave-philosopher Epictetus was one of the exiled. He found, however, some flatterers among the poets, such as Martial, Silius Italicus, and Statius. The most important event of his reign was the conquest of Britain by AGRICOLA; but the reign of Domitian was anything but favourable to the Roman arms, except in Britain. In Mœsia and Dacia, in Germany and Pannonia, the armies were defeated and whole provinces lost. Domitian himself went twice into Mœsia to oppose the Dacians, but after several defeats he concluded a disgraceful peace with their chief, Decebalus; and yet Domitian made a pompous report of his victories to the senate, and assumed the honour of a triumph. In 93 a persecution of the Christians is recorded in the history of the church, but it seems that it was not directed so particularly against them as against the Jews, with whom the Christians were then confounded by the Romans. The conspiracy of Antonius thoroughly frightened the emperor, who felt keenly the universal hatred he excited. His savage, cowardly tyranny from this time is appalling. Rome was in perpetual terror; no man was safe from Domitian's caprice. An army of spies reported continually to him, inflaming his passions. It was a foretaste of the horrors of the Reign of Terror in the French Revolution, but with the added touch that no man knew his crime or wherein he might offend. In 96 a conspiracy was formed against Domitian among the officers of his guards and several of his intimate friends, and his wife is said to have participated in it. He was killed in his apartment by several of the conspirators. On the news of his death the senate assembled, and elected M. Cocceius Nerva emperor.



Coin of Domitian.

The character of Domitian during the last years of his reign is represented by all ancient historians in the darkest colours. His curious mixture of official moral rigour with the loosest actual conduct, is shown by his prosecution to the last rigour of the offending vestal virgin, while at the time he was openly living with his own niece. Yet when it was suggested to him to marry her, he, and probably with sincerity, expressed the greatest horror (so close a connection between husband and wife not being allowed by Roman law). In fact, as Merivale has shown ("Roman Empire," 1865), Domitian was, at all events at first, perfectly sincere in his religious tyranny. Paganism was purely formal by this time; sacrifices and legal acts, not moral purity, were required. Even a man as depraved as Domitian, if he fulfilled the stipulated religious and political duties, would be held to be a "pious" or religiously virtuous man. But there is reason to think that though his earlier cruelties were, from the Roman point of view, only well-merited but over-severe punishments, yet at last he grew to love cruelty for its own sake, and became a bloodthirsty monster like Caligula or Nero.

DOMI'TIUS AHENOBARBUS, was the name of a powerful family of the great Domitian gens or clan of ancient Rome. A certain Domitius encountered the white horsemen who rode into Rome with news of the victory of Lake Regillus, which assured the power of the young city (B.C. 496). These horsemen, to prove their supernatural authority, touched the beard of Domitius, and it changed from black to a copper red; whereupon the surname of Ahenobarbus, the "brazen-bearded" or "copper-bearded," was fixed upon him. The strangers were always believed to be CASTOR and POLLUX. Among many eminent members of this family, during Rome's long history, the following may be mentioned:—

CNÆUS DOMITIUS AHENOBARBUS, son of a consul who drove the fine *Via Domitia* through Gaul, was tribune of the plebs, and as such brought in the bill of the *Lex Domitia* (B.C. 104), and thereby secured the election of the official priesthood by the people. He was himself made Pontifex Maximus, and became consul in 96 with Crassus the orator.

LUCIUS DOMITIUS AHENOBARBUS, brother of the last, was consul in 94, and so firm a partisan of Sulla that Marius the Younger, when consul, had him murdered in 82, while Sulla had not yet returned from his Eastern campaign.

CNÆUS DOMITIUS AHENOBARBUS, nephew of the last and son of the former, was opposed to his uncle Lucius. He was consul in 94, and afterwards became a violent supporter of Cinna, whose daughter he married. He was proscribed by Sulla on his return to Italy in 82. Ahenobarbus fled to Africa, and fell there in 81 by the hand of Pompey the Great, who defeated him and his ally, the Numidian king Hiarbas, in a pitched battle. His brother LUCIUS married the sister of Cato of Utica, and opposed Cnæus in politics. He was consul in 54. He occupied Corfinium when he heard of Cæsar's invasion of Italy at the beginning of the great Civil War, 49, and offered the only armed resistance the great general met with in his march on Rome. Corfinium fell in a very few days, the troops refusing to fight against Cæsar, and Ahenobarbus fled to Marseilles, whence he joined Pompey in Greece, and fell by Antony's own hand in the battle of Pharsalia, 48. (To show the vastness of the possessions of the principal men at this period, it may be mentioned that Ahenobarbus had promised, if they were victorious, to give each soldier of his detachment of 20,000 men—the left wing—4 jugera of land out of his own property; 4 jugera being equal to 2½ English acres, the total land promised amounting to 50,000 acres.) His son CNÆUS shared his father's campaigns, but on his return to Italy, B.C. 46, was pardoned by Cæsar. On the dictator's assassination he at first joined Brutus, but was won over by the crafty Mark Antony. He was consul in 32, and deserting Antony, assisted Augustus to win the empire at the battle of Actium.

LUCIUS DOMITIUS AHENOBARBUS, son of the last-named, married the daughter of the emperor's sister Octavia, by Mark Antony. After Antony's desertion Octavia had brought up her children in Rome. Lucius was consul in A.D. 16. His son CNÆUS married Agrippina the Younger [see AGRIPPINA], daughter of Germanicus, and by her became the father of the last of the Ahenobarbi, Lucius Domitius Ahenobarbus (born A.D. 37), who, being adopted by the Emperor Claudius in 50, changed his name to Nero Claudius Cæsar Drusus Germanicus; and who four years afterwards, by the murder of his adoptive father, succeeded to the throne as the Emperor NERO.

DOM'NA, JULIA, whose beautiful statue is one of the glories of the Vatican, was born at Emesa, in Syria, of obscure parents. The Emperor Severus, while governor of Southern Gaul, married her, being informed by the astrologers that she had a "royal nativity." She patronized literature and the arts as empress, and entered largely into the details of government, even acting as a kind of

regent to her sons, Caracalla and Geta, after the emperor's death. Geta was murdered in Julia's arms by the fratricide Caracalla. The empress was forbidden to show any grief for her son, and still continued to serve the state faithfully under the tyrant who called her mother. His cruelties having caused his assassination, Macrinus, who seized the throne, feigned to treat the ex-empress, powerful in the general affection, with some distinction. She discovered, however, that he meant evilly towards her, and to avoid falling into his hands she voluntarily starved herself at Antioch in 217. Both Dion Cassius and Aurelius Victor accuse Julia Domna of considerable levity of conduct during her earlier married life. She was, however, universally beloved and respected by the best men of the time, and by her cold and austere husband; and as Gibbon says, referring to the astrological prediction about her, "deserved all the stars could promise her." Julia Domna was a great protector of literature, the arts, and religion; and a proof of the energy of her work in the latter respect was discovered at Rome in October, 1883, in the Palatine excavations, when Bacelli unearthed the temple-quarters of the Vestal Virgins, rebuilt by the empress at the close of the second century, after their damage by fire in the conflagration of 191 A.D.

DOMREMY-LA-PUCELLE, a village of France in the department of the Vosges, situated on the Meuse, 7 miles N. of Neufchâteau. It is the native place of Joan of Arc (*La Pucelle*, "the maid"), who was born in 1412.

DON (the ancient *Tanais* and the Tartar *Tuna*), a river of European Russia, rises in the small lake Ivanovskoi, in the government of Tula, and thence flows in a general S.S.E. direction, through the governments of Ryazan, Don-Cossacks, Tambov, and Voronesh, to the town of Paulovsk, receiving within these limits the Sosva, the Voronesh, and the Sosna. Below Paulovsk it runs east through the territory of the Don-Cossacks to within about 35 miles of the Volga. Turned by the mountainous region on the west bank of the Volga, it then proceeds in a south-western direction to the Sea of Azof, which it enters by three mouths, having received in this part of its course, from the right bank the Donetz, the most considerable of its tributaries, and from the left bank the Medvieditza, the Manitch, and the Sal; the two latter rivers flow from the Caucasian Mountains. The length of its course is estimated at about 880 miles. The width varies from 850 to 1200 feet. This river has a slow current, and abounds in shallows and sandbanks, but has neither falls nor whirlpools. In spring it overflows its banks, and forms broad and unwholesome swamps; it is navigable as high as Zadonsk on the north-western border of Voronesh, and has depth of water enough from the middle of April to the end of June for large vessels, but is so shallow during the remainder of the year that there is scarcely 2 feet of water above the sandbanks. Its mouths are so much choked with sand as to be unnavigable for any but flat boats. The waters of the Don abound in fish. A canal, projected by Peter the Great, joins the Don and the Volga. It commences a little north of 50° N. lat., in the Illavlia, which enters the Don near its most eastern point, and terminates in the Kamychenka, a feeder of the Volga, the whole length, including the canalization of the two rivers, being about 90 miles.

DONAGHADEE', a market-town and seaport of Ireland, in the county of Down, Ulster, situated on the southern side of Belfast Lough. It is connected with Belfast and Bangor by railway, and is 22 miles from Portpatrick, on the opposite coast of Scotland. A large pier and a lighthouse have been erected, which much improves the harbour, which admits vessels drawing 16 feet of water, and the town has a considerable import and export trade. The chief exports are cattle, grain, and horses, and the imports coal and timber. The town is well built, and contains several places of worship and schools. Embroidery is here carried on to a considerable extent, and there are many flax mills. The town is also the chief station of the Down fishing district. Population, 2200. There is a curious rath or mound on the N.E. side of the town which is now used as a powder magazine. It is 480 feet in circumference at the base, and 140 feet high, with a small modern tower on the summit. A university is said to have formerly existed near, but it was destroyed by the Danes in 837.

DONATEL'LO. *Donato di Betto di Bardo*, called *Donatello*, was born at Florence in 1386. He received his first instruction from Lorenzo Bicci, from whom he learned painting in fresco; but he afterwards became more famous as a sculptor and worker in bas-relief. He also practised architecture. In the course of his life he visited many towns of Italy, among which were Venice and Padua, where the people wanted to detain and naturalize him, and Rome. Donatello was much esteemed by his contemporaries, and executed a great number of works, both in private and public buildings, and for the Grand-duke Cosmo I. He was the first to employ bas-relief in telling stories, according to the more elaborate style of Italian sculpture. He died paralytic, 13th December, 1466.

His principal works are at Florence. One, a figure of St. Mark, a portrait of Fra Barduccio Cherichini, in one of the niches of Giotto's Campanile, nicknamed Lo Zuccone (the Gourd) on account of its bald head, is much commended. Vasari, speaking of a Judith bearing the head of Holofernes, in bronze, calls it a work of great excellence and mastery. His equestrian statue of Gattamelata at Padua is perhaps the best known; but the finest is the ideal figure of St. George, the perfect Christian embodiment of a soldier-saint, ready to face suffering and death. It will be found engraved in outline in the Plates to the article SCULPTURE. Three beautiful original bas-reliefs in marble by Donatello are in the South Kensington Museum, as well as casts of his chief works.

DONA'TIO MOR'TIS CAU'SA, a gift made in prospect of death. The doctrine is derived from the Roman law, and a donation of this kind is defined in the Institutes (ii. tit. 7) as "a gift which is made under an apprehension of death, as when a thing is given upon condition that, if the donor die, the donee shall have it, but that the thing given shall be returned if the donor shall survive the danger which he apprehends, or shall repent that he has made the gift; or if the donee shall die before the donor." In the English law it is necessary to the validity of this gift that it be made by the donor with relation to his dying by the illness which affects him at the time of the gift, but it takes effect only in case he die of that illness. There must be a delivery of the thing itself to the donee; but in cases where actual transfer is impossible, as, for instance, goods of bulk deposited in a warehouse, the delivery of the key of the warehouse is effectual. A cheque is a good delivery. A "donatio mortis causa" partakes of the nature of a legacy so far as to be liable to the debts of the donor; but as it takes effect from the delivery, and not by a testamentary act, neither probate nor administration is necessary, nor the assent of the executors.

In the law of Scotland a *donatio mortis causa* has been defined as a conveyance of an immovable or incorporeal right, or a transference of movables or money by delivery, so that the property is immediately transferred to the grantee, on condition that he shall hold for the grantor as long as he lives, subject to the grantor's power of revocation, and, failing such revocation, then for the grantee on the death of the grantor. (See Morris *v.* Riddick, July 16, 1867, 5, Macph. 1036.) Donations of this kind were formerly rare in Scottish practice. They now appear to be subject to much the same rules as those given above as applicable in England.

DONATION OF CONSTANTINE. See DONATION OF PEPIN.

DONATION. *Donation of Pepin*, a transaction, whereby for the patriciate of Rome and kingdom of France Pepin bartered the exarchate of Ravenna, which was the true foundation of the eleven centuries of temporal sovereignty of the popes. Gregory II. took advantage of the Emperor Leo's attack upon the images of the Catholic Church to raise the cry of heresy. The empire, feeble in itself, with its seat at the distant Constantinople and its weak show of Italian viceroyalty at Ravenna, where dwelt the exarch, was no match for a really national movement in Italy. The Italians, once roused, wished to go on and invade Greece, eject the heretic emperor, and substitute a faithful son of the church in his stead, and Gregory had some difficulty in restraining their zeal within manageable bounds. The exarch was allowed to return to Ravenna and nominally to exercise the government in the name of Leo; in reality he was little more than a prisoner, and Italy had shaken off the shackles of the empire. To the fact that no great Italian was ready to seize the heritage thus lying to his hand, and that it consequently became a ball to be tossed to and fro between pope and German emperor, are due the centuries of intestine feuds and misery of the unhappy country. Cut up into petty states it remained until our own times a hotbed of intrigue, treachery, and crime. no one state able to bring the rest into order, and the whole therefore at the mercy of wave after wave of foreign dominion from Pepin to King Bomba and the Austrians.

It was not Gregory's fault that the popes did not take the proud position of kings of Italy. Till now the pope had been hardly the equal of the Patriarch of Constantinople; he had been the servant of the empire. But the movement against Leo showed Gregory his power, and he waited to gain strength enough to seize on the exarchate of Ravenna. The Gaulish savage nation of the Longobards, however, anticipated the priests, and Astolphus their king, suddenly seizing Ravenna and the exarchate, roughly dictated terms to Rome, every Roman to purchase his miserable life, year by year, for a gold piece—those who did not pay to be killed. Gregory II. temporized, meanwhile sending urgent entreaties to Charles the Hammer (Martel), the actual king of France. Childeric, the last of the Merwings, was the nominal sovereign of France, but the power was in the hands of the "mayor of the palace." Charles sent a fruitless embassy to Ravenna, but his successor, Pepin, came to the help of Gregory's successor, Stephen III., with an army which he and the pope led in person. Astolphus at once submitted, restored Rome to her newly gained freedom, and swore to respect the sanctity of the popes. But hardly had the Franks withdrawn than he invested the sacred city. St. Peter himself now loudly called on his "adopted son" to return to the deliverance of his flock (probably Stephen's hand held the pen) in a curious apostolic epistle still preserved; and Pepin did return in wrath, drove out the Longobards, and presented the splendid territory of the exarchate to the pope as a temporality.

This is an authentic and historical fact, though the limits of the "donation" are not perfectly ascertained. Certainly Ravenna, Bologna, Ferrara, and the whole land between Rimini, Ancona, and the Apennines was included. In return Pepin was proclaimed King of France by the grateful pope, and made Patrician of Rome. Rome now resumed, in name at least, her government by "Senatus Populusque," the patrician being the president of the senate and the governor of the city. St. Boniface, and later Stephen III. himself, crowned the new King of France, reviving the ancient Jewish rite of anointing for the greater solemnity. (This revival has been almost universally maintained in the subsequent coronations of every land.)

Donation of Charles the Great (*Charlemagne*).—Charles, son of Pepin, made the patriciate a real thing, coined money, and administered justice in his own name. He seemed to think his father and himself (for he had added largely to the donation of Pepin in the flush of victory over the Longobards, whom he utterly destroyed in 774) had gone too hastily to work. While he professed great respect for the pope (Adrian I.) he not only made real what was intended to be the complimentary title of patrician, but he also reduced to a mere titular dignity what had been undoubtedly an actual donation. The Archbishop of Ravenna indeed was as powerful in the exarchate as was the pope, and Charles was the master of both.

Donation of Constantine.—In this strait the successors of St. Peter stooped to a silly and manifest forgery. It was probably the notorious Isidore, archbishop of Seville, who soon after Charlemagne's death concocted the spurious "Donation of Constantine"—for the equally spurious "Decretals" of the twenty earliest popes (which Nicholas I. shortly before his death in 867 adopted as genuine and added to the true collection of Dionysius, a shameful act endorsed also by Gregory IX. in his collection in 1227) are unanimously attributed to him, and the Donation of Constantine is enshrined among them. In the false Decretals the supremacy of the pope over the church, the right of appeal to Rome, countless directions as to dignities and ritual appear; they are indeed the foundation of the Romish spiritual supremacy. In the false "Donation" the first Christian emperor, his baptism being antedated in the most audacious manner, gives to Pope Silvester "palatium nostrum, et urbem Romam, et totius Italiæ civitates" (our palace, and the city of Rome, and all the states of Italy). So deep was the credulity of the times that this absurd fiction, after it had been cautiously allowed to become gradually known, was received as authentic both in Greece and Italy on its promulgation. By this therefore Pepin and Charlemagne during the century preceding the formal acknowledgment of this "ancient" title to the land of Italy had done no more than restore to the popes what had always been their own. Certainly the Donation may match with the Decretals, and the subsequent history of both is equally astonishing. So soon as literature revived in the times of the Renaissance, Laurentius Valla, a Roman patriot, exposed the sham, printing the pseudo-Donation in full as an incitement to Rome to secure her liberty now that the pope (Eugenius IV.) had fled and a good chance offered itself. This was in 1440. Dante also, writing about this time, showed the doubt he dared not more openly express. But by the time of Ariosto it was openly laughed at. See the "Orlando Furioso" (xxxiv. 80), enumerating among the things lost on earth and found in the moon,

"Il done
Che Constantino al buon Silvestro fece."

The celebrated Cardinal Baronius, writing about 1600 is so ashamed of the clumsy forgery that he tries to support a theory that the offer was made by Constantine and *refused* by Silvester. "I spoke of this one day with the pope" (Clement VIII.), says the Cardinal du Perron, a contemporary of Baronius', "and he answered, *laughing*, 'Che volete? I Canonici la lengono?'" (What do you want more? The Canonists smooth it over.) Yet pope after pope have unblushingly affirmed the authenticity of Constantine's Donation.

DON'ATISTS, a powerful sect of the early Christian Church of Northern Africa, which arose in the early part of the fourth century. During the persecution under Diocletian some of the officers of the church had surrendered their copies of the Scriptures, and a controversy arose as to whether such persons, who were termed *traditores*, remained members of the church. This led in 311 to the election of rival bishops at Carthage and a division in the church, which soon spread throughout most of the cities of Northern Africa, and from this petty personal quarrel arose the great schism which afflicted the church for three

centuries, and indeed lasted as long as African Christianity. Rapidly the Donatists became the leading church power in Africa (400 bishops ruled as many sees), and the Catholics were excommunicated with true ecclesiastical vigour. An appeal made to the civil power to settle the dispute led to the appointment of a synod at Arles, which decided in favour of the Catholic bishop Cæcilian, who had been first ordained, though hastily and without the consent of the bishops, and this decision was confirmed by the Emperor Constantine in 316. The rival party, however, who were at this time led by the brilliant and virtuous Donatus, surnamed Magnus, and supported by all the Numidian and many other bishops, refused to submit, and when persecution was attempted the Donatists took up arms, enlisted soldiers, and successfully resisted the imperial troops. In addition to their rejection of the traditores the Donatists maintained that the integrity of the church depended not on the apostolical succession of the bishops, but rather on the personal holiness of its members. They denied the right of the state to meddle with ecclesiastical affairs, maintained that the efficacy of the sacrament of baptism depended on the character of the administrator, and carefully rebaptized all converts made from the Catholic party in the church after a suitable penance. Churches defiled by the Catholics had their walls scraped and their altars burnt by the Donatists, and underwent the most stringent purification. Continually growing in fanaticism and exclusiveness, while yet the Arian schism tore the church asunder in Europe, the Donatists had developed extreme parties among themselves; and of these the chief were the *Circumcellions*, whose ranks were filled by the barbarian peasants of Numidia and Mauritania, densely ignorant, fervidly superstitious, and furious in their enthusiasm for their Donatist chiefs. When, therefore, Constantine exiled their bishops and drove whole communities into exile, they rose with the peculiar ferocity only found in religious wars, elected "captains of the saints," established communism, and executed terrible measures of retaliation; so that St. Gregory Nazianzene cries out, when recording the crimes of both sides, that the "kingdom of heaven has been turned into a very hell" ("Orat.," i. 33).

On the accession of Julian in 361 the Donatist bishops were reinstated in their sees, and the sect increased greatly in power and influence. In 410 a council was assembled at Carthage under the Emperor Honorius, which was attended by 286 Catholic and 279 Donatist bishops. The Donatists were opposed by St. Augustine, and after a discussion lasting over three days, the decision was given against them by the imperial commissioner, and this was confirmed by the emperor. Persecution of the most stringent kind was at once resorted to, with the full approval of St. Augustine; thousands of Donatists perished as martyrs or suffered crushing fines, reducing them to misery. It is not to be wondered at, therefore, that they warmly supported the invasion of the Vandals under the terrible Genseric in 429, for that astute barbarian presented himself to the Donatists as a deliverer. Intestine division and the stern Arianism of Genseric preyed upon the Donatists, who now yearly diminished in importance. They, however, continued to exist as a separate body until the Saracen invasion at the beginning of the seventh century, when they disappeared along with the rest of the Christian Church of North Africa. (See the splendid edition of Optatus Milevitanus by Dupin, Paris, 1700; and the very full account of Du Tillemont, "Memoires pour servir à l'Hist. Eccl. des 6 premiers Siècles," Paris, 1701.)

DON'CASTER, a market-town and municipal borough in the county of York, 37 miles S. by W. from York, and 156 miles from London by the Great Northern Railway, which is connected with the Midland and South Yorkshire lines, and has its carriage factories, engine works, and other establishments planted here. Doncaster is one of the cleanest and pleasantest towns in Yorkshire. It is situated on the west bank of the Don, and occupies the site of the Roman *Danum*, some remains of which are from time to time discovered. The Northumbrian kings afterwards resided in it, and from its position on the great north road it was frequently exposed to the "storms of battle." Malcolm of Scotland did homage here in 1157 to Henry II. In the rebellion of 1470 against Edward IV., two of the leaders were beheaded in the market-place. It was the scene of the pacification in 1536 which terminated the great rising known as the "Pilgrimage of Grace;" and in the Civil War was several times visited by Charles I. and the parliamentary generals. Its horse races were established about the beginning of the eighteenth century, but acquired no distinction until Colonel St. Leger founded the St. Leger stakes in 1778. The races take place annually in September, and last four days. The course is about a mile from the town. St. George's, the parish church, built in 1855, is one of the stateliest religious edifices in Great Britain. The tower is 172 feet high, and is the only portion preserved of the ancient church, destroyed by fire in February, 1853. It is the highest tower of any parish church in England except Boston. St. James' is also modern, erected principally to accommodate the railway "colony," which numbers about 5000. Doncaster has no manufactures, but its trade is considerable. It contains a well-built mansion-house, guild-hall, infirmary, grammar-school, a cattle market, and a commodious corn exchange, completed in 1873. There are also numerous places of worship for various sects, and several local charities. The borough is divided into three wards, and governed by six aldermen and eighteen councillors, one of whom is mayor. The first power-loom, invented by Cartwright, was established in this town at the inventor's own expense in 1786. The machinery was at first moved by a bull. The population of the borough in 1881 was 21,139. The interesting ruins of Conisborough Castle are about 5 miles W.S.W. of the town.

DON-COSSACKS, PROVINCE OF THE. The province of the Cossacks of the Don acknowledges the Czar of Russia as its chief, and is now reckoned as one of the governments of the empire. It lies between 47° and 51° 11′ N. lat., 37° 20′ and 44° 45′ E. lon.; and is bounded N. by the provinces of Voronesh and Saratov, E. by Astrakhan, S. by Caucasia and the Sea of Azof, and W. by Ekaterinoslav and Voronesh. Its area is 59,650 square miles, and the population at the last census amounted to 1,100,000.

The general character of the country is that of a plain, in many parts consisting entirely of steppes. The interior is a complete flat, but in the north and along the banks of the Don there are slight elevations, and the south-eastern parts are traversed by low offsets of the Caucasian Mountains. The rest of the country is a broad steppe, which contains abundance of luxuriant pasturage, intermixed with tracts of sand. The whole territory does not contain a single forest, and even brushwood is only occasionally found. The steppes are full of low artificial mounds and ancient tumuli, supposed from the features and head-dress of the rude stone images erected over some of them to be of Mongolian origin. Many of these tombs have been opened, and found to contain gold and silver urns, rings, buckles, &c.

The chief rivers are the Don and its tributaries, and some smaller streams that flow directly south from the steppes into the Sea of Azof; the principal of these is the Molotchna. The principal lake is the Bolskoi, which is about 70 miles long and 9 broad; it is traversed by the Manitch, and forms part of the boundary between the territory of the Don-Cossacks and Caucasia.

The chief town is Tcherkask. The inhabitants still retain many of their own peculiar laws and usages. The country enjoys a mild climate. The spring sets in early, and in summer the land is refreshed by frequent showers; the autumn is at times damp and foggy, and the winter,

though clear, is severe and attended by much stormy weather. The rivers are ice-bound from November to February.

All the north and east of the country is inhabited by the Don-Cossacks and hordes of Calmuck and Nogay Tartars, who until lately led the roving life of nomads. The western district, lying between the Donetz, the Don, and Ekaterinoslav, is inhabited by German colonists, principally Mennonites from Prussia, and is one of the most prosperous and best cultivated portions of Russia. The Nogays have been compelled to settle in villages and devote themselves to agriculture, the process of which, as well as of other common industrial arts, they have readily learnt from their German neighbours. The Don-Cossacks have always been in some degree agriculturists, but chiefly cattle-breeders; and indeed these are the principal occupations of the three great divisions of the population. Vast quantities of wheat, the most important article of cultivation, are produced, and large exports are made by the ports of the Sea of Azof. After wheat, merino wool is the most important produce of the steppes. The Mennonites possess immense flocks of sheep, but the wool is far from being so valuable now as it was formerly. Barley, oats, maize, and buckwheat are also raised, as well as pease, beans, flax, and hemp. The vine is cultivated to a considerable extent, and wine of a good quality to the amount of £100,000 a year finds its way to Moscow and other towns in the interior. Horses are very numerous. The native Cossack horse is small and spare in flesh, with a thin neck and narrow croup; he is, on the whole, an ill-looking animal, but strong, fleet, and hardy. The poorer Cossacks have each three or four horses, but many of the tabunes, or herds, of the wealthier breeders contain 1000 or more. All, with the exception of the saddle-horses, are kept on the pasture-grounds throughout the year, and in winter are forced to seek for their food either beneath the snow or from the high reeds on the banks of rivers. Dromedaries are reared by the Calmucks, and thrive well on the saline plants on the steppes. The ox is used for draught; goats are bred principally by the Calmucks, and are used as leaders to the sheep over the steppes. Fish in large quantities are taken in the Don and its tributaries, and along the shores of the Sea of Azof. Honey and wax, to the amount of 300,000 lbs., are annually produced. The exports consist of horses, cattle, fish, tallow, hides, and skins, the agricultural produce named above, and also of caviare and isinglass. Salt is gathered in summer from the evaporated lagoons along the sea.

The origin of the people from whom this district takes its name, and who are widely spread over Southern Russia, is uncertain. The word *Cossack* means nomadic or wandering, and was an appellation applied by the Tartars in the thirteenth century to the people of nomadic habits whom they found in occupation of the country at the period of their irruption. They are of Slavonic race, and seem to be the same people before called Polortzis, "a collection of fugitives and malcontents from different quarters, the numbers being too small to permit the supposition that they were a distinct nation." They speak pure Slavonic, and are all of the Greek religion. They regard the designation *Cossack* as a by-name—know none such among themselves; "true believers" is the only appellation they assume. They are not, however, pure Slavonians, as we know that the Don country was long a soil of freedom, and an asylum for all refugees. They appear first in history in the thirteenth century, on the fall of the Tartar Empire, and begin to figure in the Muscovite annals. In the reign of Ivan IV. (the Terrible) they placed themselves under the protection of Russia. They sometimes marched under her banners, and sometimes, by taking part against her, brought the empire to the brink of ruin. Their constitution was a republic, with perfect equality among all persons in the nation. Aristocracy was unknown, and the only distinction was that of deeds. It was, however, established by some of their chiefs, serving in the Russian armies, being raised to the rank of nobles, and authorized by ukase to retain their titles and privileges on their return to their own country; thus boldly infringing a first principle of their democratic constitution—the perfect equality of all persons in the nation. Several insurrections followed, but were put down one after the other, leaving them in a worse condition, till their spirit was at length completely broken.

DONEGAL', a county of Ireland, in the province of Ulster, is bounded E. and S. by parts of the counties of Londonderry, Tyrone, Fermanagh, and Leitrim; and S.W., W., and N. by the Atlantic Ocean. The greatest length, N.E. and S.W., is 85 miles; the greatest breadth, S.E. and N.W., is 41 miles. The area is 1865 square miles, or 1,193,448 acres. The population in 1881 was 206,035. The occupations are chiefly agricultural. Donegal forms the north-western extremity of Ireland. The inland boundary preserves a general direction of south-west by north-east, and from Lifford northward is formed by the river Foyle and the harbour of Loch Foyle. The maritime boundary is extremely irregular, being deeply indented on the north by the estuaries of Loch Swilly, Mulroy, and Sheephaven, and on the south by Donegal Bay. The whole county is uneven and mountainous, with very few exceptions. The mountain groups of Donegal, together with the highlands of Tyrone and Derry, present a deeply withdrawn amphitheatre to the north-east, inclosing the basin of the Foyle. These mountains include eight summits, varying from 1200 to 2500 feet in height. The coast of Lough Foyle between the mountains of Inishowen and the sea, is well inhabited and improved. Lough Swilly extends inland upwards of 20 miles, and forms a spacious and secure harbour; but the vicinity of Lough Foyle, which floats vessels of 900 tons up to the bridge of Derry, renders Lough Swilly of less importance as a harbour. In the sound between Horn Head and Bloody Foreland are the islands of Inisboffin, Inishdoony, and Tory Island, which last is at a distance of 8 miles from the shore, and is inhabited by a primitive race who seldom visit the mainland of Ireland. From Bloody Foreland southward the Atlantic coast of the county is extremely dreary, exhibiting moors, sandbanks, and pools of bog-water. There are many islands near the shore, of which the chief are—Aranmore, Inismacdurn, Inisfree, and Owney. The desolate district called the Rosses is separated by the river Gweebarra from a more reclaimed country about Glenties and Ardara. Near Malin Beg Head, at the western extremity of Donegal Bay, is a sea-cliff which rises to a perpendicular height of 1964 feet. Many of the adjoining cliffs are also very lofty and rugged. Donegal Bay contains many sheltered creeks and the good harbours of Donegal and Killybegs. North-eastward of the town of Donegal lies a good tract of arable land, stretching inland to Lough Eask and the Gap of Barnesmore.

The Foyle is not so much a river as an estuary for several rivers. It receives the waters of the Finn, the Derg, and the Deele; while Lough Swilly receives those of the Swilly, the Leannan, and the Lackagh. Among the rivers of the western coast are the Gweebarra, the Gweedore, and the Owenea. There are many lakes in the county, of which the chief are Lough Derg, Lough Deele, Loch Gartan, Lough Eask, Lough Salt, and Lough Glen. Some of these lakes, though small in area, are very deep.

The climate of Donegal is raw and boisterous, except in the sheltered country along the Foyle. The prevalent winds are from the west and north-west, and the violence with which they blow is sometimes excessive. From the remains of natural forests in many situations where no timber will at present rise against the north-west blast, it has been inferred that the climate is now more severe than it formerly was.

The geological formation of Donegal is mostly primitive. The prevalent rocks are granite and mica slate, passing into

gneiss, quartz slate, and clay slate. Granular limestone is found in beds throughout the whole mountain district in great quantity and variety of colour, and a very extensive bed of white marble, of an excellent quality, occurs at Dunlewy. The soil of the primitive district is generally cold, moory, and thin. The limestone tract from Ballyshannon to Donegal is covered with a warm friable soil, varying from a deep rich mould to a light brown gravelly earth. The soil of the transition district, arising chiefly from the decomposition of slaty rock, is a light but manageable clay, which is very well adapted for crops of potatoes, flax, oats, and barley. The agricultural implements have been improved of late years, but there is still room for much further advance in this respect. In the western parts spade husbandry is still pursued. Formerly grazing was only practised to a very limited extent, but it is now followed with great energy and success. Much care is taken in the selection of the breeds, and large numbers of cattle and sheep are exported. Fish is abundant on the coast, and forms a chief article of food with the peasantry; but the fisheries might easily be made much more productive than they are. The fishermen usually fill up their time in agricultural pursuits, and prefer this mode of life to that on the sea. Some improvements have, however, recently been introduced in the fisheries by the North-western Fishery Company.

The linen manufacture is carried on to a very considerable extent, especially about Raphoe and Lifford, and in the neighbourhood of Ballyshannon. Woollen goods for local use are also made, and many of the females are employed in embroidering muslin for the Belfast and Glasgow houses. Large quantities of kelp are also made from seaweed for exportation to Glasgow.

Donegal is divided into six baronies. The assizes are held at Lifford. The only towns with a population of over 2000 in 1881 are Ballyshannon, which had a population of 2840 persons, and Letterkenny, which had a population of 2188.

History and Antiquities.—The southern part of Donegal was known as Tyrconnel, and was the patrimony of the O'Donnells, whose chief tributaries were the O'Boyles in Boylagh and the Rosses; the MacSwineys (MacSuibhne) in Bannagh, Rossguill, and Fanad; and the O'Doghertys in Inishowen. The most distinguished of the chieftains of Tyrconnel was Hugh O'Donnell, who was engaged in active civil war against the government during the reign of Queen Elizabeth. These contests were continued in the early part of the seventeenth century, until at length, in 1608, Donegal, along with five other counties of Ulster, escheated to the crown, and was planted or granted as English and Scotch colonies. The political events of subsequent date have been few and unimportant.

The most remarkable piece of antiquity in Donegal is the Grianan of Aileach, the palace of the northern Irish kings from the most remote antiquity down to the twelfth century. It stands on a small mountain 802 feet in height, near the head of Lough Swilly. The summit of the mountain, which commands a noble prospect, is surrounded by three concentric ramparts of earth intermixed with uncemented stones. The approach by an ancient paved road leads through these by a hollow way to a dun or stone fortress in the centre. This part of the work consists of a circular wall of Cyclopean architecture varying, in breadth from 15 feet to 11 feet 6 inches, and at present about 6 feet high, inclosing an area of 77 feet 6 inches in diameter. The wall has galleries, terraces, and doorways cut in its thickness. The remains of a small oblong building of more recent date, but of uncertain origin, occupy the centre. The space contained within the outer inclosure is about 5½ acres; within the second, about 4; within the third, about 1; and within the central building, ¼. The stones of the wall are generally about 2 feet in length, polygonal, not laid in courses, nor chiselled, and without cement. On Tory Island are some Cyclopean remains, a round tower, and remains of two stone crosses and of seven ancient churches. Throughout the county are numerous memorials of St. Columba, or, as he is more usually named in Ireland, St. Columbkille. Near Kilmacrenan is the Rock of Doune, on which the O'Donnells were inaugurated as princes of Tyrconnel. The remains of the Abbey of Donegal still possess interest for the antiquarian, and on the north of Glen Veagh are some very ancient remains of churches. But by much the most celebrated ecclesiastical locality in this county is the Purgatory of St. Patrick, situated on an island in Lough Derg; it consists of a cave and buildings, in which priests assist at a Roman Catholic festival, at which large numbers of pilgrims attend annually.

DONEGAL, a market-town and seaport of the above county, is situated on a small shallow inlet of the Bay of Donegal, where it receives the waters of the Eask. The town and harbour are both small, but the latter admits vessels drawing 12 feet of water, and has a convenient quay. Butter and grain are exported; there is a small fishery, some flax-scutching mills, and sulphur springs in the vicinity. There is a fine old castle, a seat of the O'Donnells, chiefs of Tyrconnel, and the ruins of a monastery in which the celebrated "Annals of the Four Masters" are said to have been written. Population, 1400.

DON'GOLA or **DON'KOLA**, a town of Egypt, in the province of Nubia, capital of a district of the same name, situated on the Nile, about 45 miles above the first cataract. It has a considerable trade and an indigo factory, and is a military station. The barracks were erected on a plan of the naturalist Ehrenberg. Near it, on the island of Argo, are some ancient ruins. It is known as New Dongola or Marakah, to distinguish it from the decayed town, 75 miles S.S.E., known as Old Dongola.

DONIZET'TI, GAETANO, the famous opera composer, like many other men of genius had a singularly uneventful life. He was born at Bergamo, in Northern Italy, in 1798, studied at Naples, began to write operas in 1818, and continued with fatal facility to produce two, three, or four a year till 1844, so that in the twenty-six years sixty-five operas were written. He visited the great continental capitals from time to time as his engagements called him, but never was long away from Italy. He never visited England, where he gained so many triumphs. In 1844 he was seized with terrible depression, ending in paralysis, and died in 1848 near Bergamo. His remains were removed from the village graveyard to a more appropriate resting-place in Bergamo itself in 1876.

Work dashed off so hurriedly is, as may be supposed, terribly unequal, and very little of it survives. The splendid vein of original melody (often not very strictly appropriate to the words it ornaments, it is true), and the occasional outbursts of dramatic power, such as those which caused the enthusiastic Romans to carry him on their shoulders to the capitol and there to crown him, for "Zoraide" (a long-forgotten opera, produced in 1822), will cause Donizetti to be long remembered; but it is to be feared that the accurate musical knowledge now possessed by lovers of music, and the increasing demands for thoroughness of work, poetical treatment, and strict relation of musical sentiment to the words being sung, will drive the beautiful but flimsy operas of Donizetti from the stage. "Anna Bolena" (1836), long held his masterpiece, is now never heard, but "Lucrezia Borgia" (1834), "Lucia di Lammermoor" (1835), "La Favorita" (1840), still retain the full favour of the more unsophisticated habitués of the opera; and "L'Elisire d'Amore" (1829), "La Figlia del Reggimento" (1840). "Lindi Chamouni" (1842) and "Don Pasquale" (1843), are not unfrequently performed. For simple flowing melody of the modern Italian operatic school Donizetti is equalled only by Bellini and Rossini; and those pleasing

tunes on which countless fantasias and variations are yet written, and of which orchestral arrangements without number are produced, will long keep Donizetti's laurels green, even if a time should arrive when the entire works of which they form the gems are no longer to be heard. In facility of composition probably Donizetti is unrivalled. The whole of the last act of "La Favorita" (words and music) was undoubtedly written in a single night, a feat apparently impossible; and this is by every one admitted to be a masterpiece in the style. Then in 1836 he saved a theatre manager from ruin (as did Mozart with the wonderful opera "Der Zauberflote") by writing an operetta, libretto and all, the plot adapted from a vaudeville seen years before at Paris, in less than one week. In nine days from the first idea the piece was performed! This was the "Night-bell." He translated many of his works into Italian when they had been written to French texts, and himself composed large parts of his libretti. The libretto of the famous last act of "Lucia" and the act of "La Favorita" already named are from his pen. Donizetti was born only six years after Rossini, but is always considered as a musical generation his junior, for Rossini wrote "Guillaume Tell," his last and greatest opera, in 1829, while "Anna Bolena," Donizetti's first production of European renown, did not appear till 1830. Bellini was four years the junior of Donizetti, but his brilliant work ("La Somnambula," "Norma," and "I Puritani") was all done between 1831 and his early death in 1835. Of the great trio of Italian opera composers of the first half of our century, Rossini, Bellini, and himself, Donizetti is therefore the latest, and he is worthy of such honourable rivals.

DON'JON (from *dun* or *dune*, a hill), the central building or keep of an ancient castle, to which the garrison could retreat in case of necessity. Its lower part was commonly used as a prison. The word is also written *dungeon*.

DONNE, JOHN, founder of what has been named the "metaphysical school" of poetry in England, whereof fanciful similitudes, remote analogies, and verbal subtleties formed rather the main body of the verse than its ornament, was born in London, in the year 1573, of respectable parents. He distinguished himself at a very early age by his ready acquisition of learning, and was sent in succession to the universities of Oxford and Cambridge, but took no degree, in consequence of the religious scruples of his family, who were Roman Catholics. At seventeen he entered Lincoln's Inn to study the law, and while there, on due reflection, became a Protestant. After travelling for about a year in Spain and Italy he became, on his return, secretary to the Lord Chancellor Ellesmere, and fell in love with and married that nobleman's niece, Anne, daughter of Sir George More. Sir George was very indignant, and not only refused to be reconciled for a long while, but managed to get Donne thrown into prison and took away his wife, whom Donne only recovered by an expensive law process. It is most characteristic of this writer that at the lowest point of his fortunes he could not resist signing a piteous letter conveying bad news to his wife with the pun, "John Donne, Ann Donne, Un-done." At length Sir George was prevailed upon to allow a trifle for their support, but his circumstances still compelled Donne to accept a residence in the house of Sir Robert Drury, in Drury Lane. He accompanied that gentleman to Paris, and on his return to England he was introduced to James I., and delighted the king by a polemic treatise against Catholicism, entitled "Pseudo-Martyr," published in 1610. James was so anxious that he should take holy orders, that Donne at length complied in 1613, and he became the king's chaplain-in-ordinary. The University of Cambridge made him Doctor of Divinity; but now, just as he was rising from his misfortunes, his happiness was embittered by the death of his beloved wife. The benchers of Lincoln's Inn presented him with their lectureship, and he became dean of St. Paul's and vicar of St. Dunstan's in 1621. His health soon failed him, but when almost in a dying state he preached what Walton has called his "own funeral sermon." This discourse was afterwards printed under the quaint title of "Death's Duel." He died 13th March, 1631. To those who wish to see characters like Donne treated in the spirit of their own time, we cannot recommend a more delightful book than Walton's "Life of Donne."

Donne, notwithstanding his quaint conceits, was truly learned, and had a rich vein of poetry, which was rarely concealed, even when most laboriously encumbered; while some of his pieces, both for thought and even melody, are absolute gems. His satires, though written in a measure inconceivably harsh, are models of strength and energy. Their merits were discovered by Pope, who (to use his own odd phrase) translated them into English. Donne's principal theological works, besides sermons, are the "Pseudo-Martyr," and a treatise against suicide, called "Bia-Thanatos."

DOOM or **DOUM** (*Hyphæne thebaica*), a remarkable palm-tree inhabiting Upper Egypt, especially the neighbourhood of Thebes, whence the specific name. It also grows in Guinea, and in the south and various other parts of Africa. It is from 25 to 30 feet high, and differs from most palms in being branched. The leaves are fan-shaped. The fruit is about the size of an orange, angular, irregularly formed, of a reddish colour, and has a thin spongy, but nutritious rind, which tastes very much like gingerbread; the palm is often on this account called the "gingerbread tree of Egypt." The poorer classes chew the rind. Unlike most palms, the doom palm has two, and often all three, of the cells of the ovary developed in the ripe fruit. The fruits are found abundantly in the ancient tombs of Egypt. The albumen of the seed is hard and semitransparent, and is turned into beads and other little ornaments.

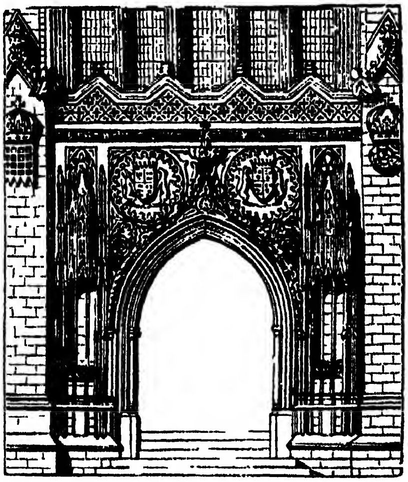
DOON, a river in Ayrshire, Scotland, immortalized by Burns in his song "The Banks o' Doon." It rises in Loch Enoch, runs north-west with a course of 30 miles through Loch Doon, and falls into the Frith of Clyde 2 miles south of Ayr.

DOOR. The door (in which we include doorway) is, as might be imagined, generally one of the most characteristic features of a piece of architecture. Sometimes it is characteristic by its comparative insignificance, as the doors of Greek architecture, where the temples were for out-of-door worship mainly; sometimes by its grandeur, as in Egyptian architecture, where its function was to admit crowds of worshippers or of subjects to the mighty temples or palaces; sometimes by its beauty, as in Gothic architecture, where it symbolizes the gate of heaven, and its office is to entice and charm the wayfarer to enter the house of God. The gates of cities are also in one sense doors, but hardly fall within the scope of the present article.

The manuals on architecture are full of considerations of the relative proportions of voids and solids in a façade, as forming, next to recesses and projections, the chief element of beauty; and while the voids above are windows, the principal void below is the door. Indeed, in the early Italian fortress-palaces of Florence the door is almost the only break in the stern line of wall at the pavement-level. The form of the aperture both of door and window is therefore of the last importance. Ruskin in his almost unequalled and felicitous manner has thus spoken on this subject:—"Doors will be, for the most part, at or near the base of the building; except when raised for purposes of defence, as in the old Scotch border towers and our own Martello towers, or as in Switzerland to permit access in deep snow, or when stairs are carried up outside the house for convenience' or magnificence. But in most cases,

whether high or low, a door may be assumed to be considerably lower than the apartments or buildings to which it gives admission, and therefore to have some height of wall above it, whose weight must be carried by the heading of the door. It is clear, therefore, that the best heading must be an arch, because the strongest, and that a square-headed door must be wrong. Thus while I admit the Greek general forms of temple to be admirable in their kind, I think the Greek door always offensive and unmanageable." ("Stones of Venice," vol. i.)

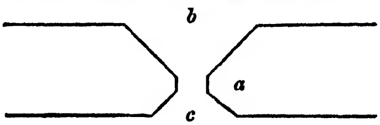
In the article ARCHITECTURE the origin of Greek architecture was pointed out, and with such an origin it is manifest a square-headed form of doorway must have been that adopted by the Greeks. Also it follows from this that the aperture is small and narrow in proportion to the general façade, or otherwise it would weaken the wall, and this, though no defect in actual use, on account of the special nature of Greek worship, lays the style open to the objection above given of the great art critic. Of so little importance are the doors that they have been altogether omitted in our Plates on GREEK ARCHITECTURE for the sake of clearness, being not necessary to the design. This treatment will be impossible with Gothic. The Egyptian doors are no real exception to this, although square-headed,



Gothic Doorway, King's College Chapel, Cambridge.

because, as will be seen on reference to our Plates on EGYPTIAN ARCHITECTURE, they are really simply designed but splendid gates rather than doors. The height of the doorway at Tentyris, shown in the Plate, is between 70 and 80 feet. The Romans adopted the semicircular arched form whenever they did not simply copy the Greeks, as shown in the doorways of the Colosseum, &c., in our Plates on ROMAN ARCHITECTURE; and the beautiful characteristic forms of the stilted arched doorway in MOORISH ARCHITECTURE, and of the Gothic doorways in ENGLISH CATHEDRAL ARCHITECTURE, are shown in our Plates under those headings. The very elegant flattened variety of the Gothic doorway, characteristic of the last of the Gothic styles, the Tudor, almost if not quite peculiar to England, is nowhere better shown than in King's College Chapel, Cambridge, a masterpiece of the style, a sketch of the principal doorway of which is found in our Plates on English Cathedral Architecture; at the same time this exquisite chapel contains some of the more ancient Gothic features, and among them the beautiful Perpendicular doorway, of which a sketch is given above.

Certain principles, however, are or should be common to all doors. There are, it is true, such doors as those through which the CAGOTS in France were compelled to pass, their lintels being purposely arranged so low as to force the wretched object of suspicious hatred to bow to the altar as he entered the sacred edifice; but with such exceptions doors must be above a man's height, must have a level threshold, must admit two persons, one going in and the other coming out, it may be, and unless for some good reason must have perpendicular door-posts, or columns, or walls. When entrance and egress are constant, as in a public building, a church, &c., square angles are inconvenient. Indeed, they would be worn away by friction. It is better, therefore, that the architect plan his doorway accordingly, as Ruskin has pointed out, "and that these angles should be splayed, and the most contracted part of the aperture made as short as possible," as at *a*.



"Further, as persons on the outside may often approach the door or depart from it, so as to turn aside from the building as they enter or leave the door, but on the inside will in almost every case approach the door or depart from it in the direct line of the entrance, it is evident that the bevelling may be very slight in the inside (as at *c*), but should be large on the outside" (as at *b*). The beautiful, deep, external sculptured doorways produced by this simple necessity of crowds are nowhere more exquisitely carried out than in our English cathedrals. The reader is again referred to our Plates. Also, it is worthy of notice, and is well shown in those Plates, that the principal or western entrance of a cathedral is nearly always in one doorway, as if to symbolize the unity of purpose with which the worshippers assemble, though for convenience' sake several pairs of doors may be contained within the same great arch, which is not without a fine symbolic meaning also; or else it is in three doorways, as if to symbolize the doctrine of the Trinity. The typical doorway, as determined by the remarks above, being about 7 feet 6 inches by 4 feet, doorways will look best which keep about this proportion, however much greater may be their actual size; narrower doorways will be inhospitable and fortress-like, wider doorways will lose the distinction between the curve of the arch and the verticality of the columns or doorposts. Of the two, as our Plates show, the arch should be wider if anything than the type. Ruskin dreams of beautiful doorways with curves "of sweep so vast that the small vertical line becomes a part of them, and one enters into the temple as under a great rainbow." Such a door is foreshadowed in the beautiful example from Durham in our Plates.

A special effect is produced by the tympani or semicircular door-headings of the Romanesque churches. Since the actual leaves of the doorways are generally square-headed, the round arch above them is in this style filled with stone, usually carrying very fine richly carved bas-reliefs. An equally special effect of the Gothic cathedral door is the elaborate massing of the richest mouldings and traceries, and the crowding of lines of statues and carvings between them, so that as one enters the deep-set church door one dives into it, as it were, through a very cave of carving. The Byzantine doorways have a somewhat similar effect, but produced by large numbers of grouped pillars and shafts of small diameter; the doorways of St. Mark's, Venice, are typical of this style.

The actual doors, or valves, are usually of wood, and are most frequently hinged to the door-posts, the straps of the hinges often coming a long way on to the door for strength, especially in Gothic work, and this part of the

hinge is often very beautifully beaten out into fine iron tracery—such doors being usually also of massive oak, and studded with heavy iron nails with bolt heads. Other varieties of doors are those in which the leaves are again hinged on themselves, so that the aperture may be either partly or wholly opened, as in *folding-doors;* others in which the doors revolve on vertical pivots, and these are called *swing-doors*, the pivot-plates usually containing strong springs which cause the doors to swing to of their own accord; and *sliding-doors* are those which push to one side into the thickness of the wall, of which kind are nearly all fire-proof doors, and the very heavy doors of great public buildings. Rarely doors are made of bronze; this is to be regretted, as so noble an effect is not to be produced by other means. The superb bronze doors of the Baptistery at Florence by Andrea Pisano and Ghiberti, divided into panels, each with its fine bas-relief of scriptural subjects arranged in the order of a connected narrative, are rightly esteemed the masterpiece of all attempts to beautify doors. The doorways of these wonderful "Gates of Paradise," as the Italians call them, are, like most Romanesque doorways, very simply treated.

DOORNIK. See TOURNAY.

DORA'DO (the Sword-fish), a constellation invented by Bayer, situated in the southern hemisphere, and cut nearly in half by a line joining α in Argo (Canopus) and α in Eridani. Half of the greater Magellanic cloud falls within this constellation. Dorado lies across the solstitial colure (90) on the 60th circle of latitude. See Plate CONSTELLATIONS, Southern Hemisphere.

DOR'CHESTER, a market-town and municipal and ex-parliamentary borough of England, in the county of Dorset, of which it is the capital, situated on the Frome, 140 miles from London by the Great Western Railway. The town is pleasantly situated on a slight elevation near the south bank of the river, and consists principally of three spacious and well-paved streets. It is unusually clean and well drained, and is said to be so healthy that doctors have no employment there! A delightful walk, well shaded, surrounds two-thirds of it. The shire-hall is a plain building of Portland stone. The corn exchange is a plain brick building, with a handsome exchange room. The gaol, built in 1795, contains the county gaol, the house of correction, and the penitentiary. There are several churches. St. Peter's is a spacious structure of Perpendicular architecture, with an embattled tower 90 feet in height. There are also places of worship for all denominations of dissenters; and a free grammar-school, founded and endowed in 1579, the government of which is vested in trustees, and which has two exhibitions to Cambridge, and one to either Cambridge or Oxford. The town also contains the county hospital, to which an elegant Gothic chapel is attached. Dorchester contains some breweries noted for the superiority of their ale, but the business carried on is chiefly agricultural. Large quantities of butter are sent to the London and other markets. It was called *Durnovaria*, meaning the "passage over the river," and *Durinum* by the Romans, *Dorneeaster* by the Saxons, and was probably built on the site of the capital of the tribe of the *Durotriges*. The town was strongly fortified when in possession of the Romans, and in its immediate vicinity are two strongly-entrenched Roman stations, and the remarkable amphitheatre of Maumbury, the most perfect in the kingdom. The last is inclosed by sloping sides or seats of chalk, rising 30 feet above the spacious arena, which, when complete, is supposed to have been capable of accommodating 13,000 spectators. Judge Jeffreys' "bloody assize" was held in the town in 1685. By the Redistribution Act of 1885 Dorchester lost the member which it used to return to Parliament. The municipality consists of four aldermen and thirteen councillors, including the mayor. Population in 1881, 7567.

DOR'CHESTER (Oxfordshire), a town 10 miles S. by E. from Oxford, and 60 from London, being 4 from the Culham station of the Great Western Railway, situated on the west bank of the Thames. In Saxon times it was a town of importance and the see of a bishopric, founded by St. Birinus in 634. It is now a small place, of 1000 inhabitants, but contains an interesting old church, which was thoroughly restored under the superintendence of Sir G. Scott. There is also a Roman Catholic chapel. Remains of a priory of Black Monks, founded in 1140, are embodied in the grammar-school. An ancient camp is situated at the junction of the Thame and Isis—

> "Whence beauteous Isis and her husband Thame
> With mingled waves for ever flow the same."

DORDOGNE, a department in the south of France, formed out of the old province of Périgord and small portions of those of Limousin, Angoumois, and Saintonge, is bounded W. by the departments of Gironde, Charente-Inférieure, and Charente, S. by Lot-et-Garonne, S.E. and E. by the departments of Lot and Corrèze, and N. by Haute Vienne. Its length from north to south is 77 miles, from east to west 69. The area of this department, the second in extent in France, is 3534 square miles, and the population in 1882 was 495,037. The department belongs almost wholly to the basin of the Dordogne. Two mountain torrents, the Dor and the Dogne, springing from the gorges of the Mont d'Or, in Puy-de-Dôme, unite near the village of Bains their waters and names to form the Dordogne, which from this point flows first north and then west for a few miles, till it reaches the western border of the department of Puy-de-Dôme. Here turning nearly due south it separates for many miles the departments of Puy-de-Dôme from Corrèze, and this from Cantal, receiving on either bank numerous streams from the offshoots of the Auvergne Mountains. Crossing in a general south-west direction the south-eastern angle of Corrèze and the north of Lot, it gains the eastern border of the department of Dordogne, a little below Souillac, whence it runs almost due west to its junction with the Garonne near Bourg, in the department of the Gironde. The whole length of this river is 250 miles, 182 of which are navigable; vessels of 300 tons go up as far as Libourne. The Dordogne is subject to the phenomenon called the BORE. Its principal feeders in the lower part of its course are—the Vezère, the Isle, which flows south from Haute Vienne as far as Périgueux, whence it turns nearly due west to Coutras; here it is joined on the right bank by the Dronne, which rises also in Haute Vienne and drains the north-west of the department; a little below Coutras the Isle runs south and enters the Dordogne at Libourne in the department of Gironde, after a course of 124 miles, being navigable from Périgueux. The northern angle of the department belongs to the basin of the Charente, and is drained by the Bandiat. A narrow strip on the southern border is drained by the Dropt, a feeder of the Garonne. Besides these there are a vast number of smaller streams, several lakes, and excellent springs. In all the waters of the department pike, trout, and eels abound. Some of the springs form jets, and others have a regular ebb and flow.

The surface is hilly; the last western slopes of the Auvergne Mountains cover the greater part of it. The ranges north of the Dordogne springing from the Limousin run generally towards the south-west; those south of that river spring from the mountain masses of Cantal, and run nearly due west. The hills are generally overgrown with woods, broom, or heath; but in many places they are bare, rocky, and very steep. The valleys of the department are long, narrow, and winding; some are of great beauty and fertility, the slopes of the hills that close them in being generally covered with vineyards; this is especially the case with the valleys of the Isle and the Dordogne.

The general character of the soil of the uplands is barrenness. The northern portion, which forms the arrondissement of Nontron, consists almost entirely of high forest land and irreclaimable moors, the only cover of which is broom and underwood; the only exception is some good grass-land between the Bandiat and the Tardoire. In the more central part, which constitutes the arrondissement of Périgueux, though the hills are not so high the soil is similar, forests and moors covering two-thirds of the surface. Rye and buckwheat are almost the only cereals grown in these districts. The deficiency of corn is supplied by the immense produce of chestnuts, which are used as human food, and also for fattening hogs, a source of great profit to the farmer. The highest land in the department is in the arrondissement of Sarlat, the hills rising to the height of from 700 to 800 feet, with sides in some places perpendicular. About Bergerac, the hills having subsided, the valley of the Dordogne opens out into an extensive plain, and here maize, wheat, pease, beans, and other farm produce are abundantly raised. Of the arrondissement of Ribérac, which is watered by the Dronne, about one-third consists of rich heavy wheat-land, and the remainder of arid gravelly soil or hungry barren sand. The vines in this district are trained to creep along the branches of elms and walnut trees, which present a beautiful appearance in the autumn, bending with the weight of the ripe grape-clusters; but by this method, though more grapes are produced, the wine is said not to be so good.

Besides the products already named, truffles (the famous "truffes de Périgord"), the best medicinal and aromatic plants in France, are abundant; fruit trees are cultivated to a great extent, especially the walnut for making oil. In the forests oak and chestnut are the prevailing trees. The annual produce of wine is 16,940,000 gallons, one-half of which is used for home consumption, and the rest exported or distilled into brandy and liqueurs; the best kinds are the white wines of the arrondissement of Bergerac. On account of the deficiency of grass-land, horses, cattle, and sheep are not numerous; but there are a large number of pigs and goats; poultry and game are abundant and excellent. Mules and asses are the common beasts of burden. The climate is mild. Winter and spring are rainy; summer is excessively hot in the valleys; the autumn is very delightful. Violent winds are not unusual, and hailstorms often do great harm to the crops in summer. The department is traversed by good roads, and by the railway from Paris to Agen and its branches.

Mines of iron, coal, and manganese are worked; marble, alabaster, millstones, and building and lithographic stones are quarried; lead, antimony, magnesia, slate, fullers' earth, plaster of Paris, &c., are found. The commerce of the department consists of its iron, wine, hams, truffled turkeys, and leather.

The department is divided into the following arrondissements—Périgueux, which contains the chief town of the department Périgueux, Bergerac, Nontron, Ribérac, and Sarlat.

DORÉ, PAUL GUSTAVE, a French artist of very original genius and immense fertility, was born at Strasbourg in 1832, and after studying at the Lycée Charlemagne, was in 1848 engaged, when only about sixteen years old, along with Bertall, to contribute sketches to the *Journal pour Rire*. That he was an artist born was evident, for from his boyhood upwards he worked incessantly and energetically without being spurred by the necessity of earning his bread. His parents were well off, and as he was making a good income by his drawings at the age of twenty, he was enabled throughout the whole of his career to live amid luxurious surroundings. The house in the Rue St. Dominique where he resided once belonged to the dukes of St. Simon. There, in most sumptuous rooms, filled with art treasures, Doré did most of his drawing and engraving; but his paintings were executed in a magnificent studio, which he had built for himself in the Rue Bayard. In point of size, furniture, and costly arrangements of every sort, this *atelier* had possibly no equal in the world; and its owner's hospitable disposition caused it to become a regular lounge for artists, literary men, and society *flâneurs* whenever he was in Paris. His collection exhibited in Bond Street was long one of the most popular of London picture galleries. He died in 1883. From the year 1848 sketches, cartoons, and pictures were poured forth in an unremitting stream. It was, however, more as an illustrator than as a painter that Doré excelled, and, like Cruikshank, it is by his illustrations of well-known literary works that he will be chiefly remembered. In 1857 his sketches of the battles of Alma and Inkerman attracted attention, but chiefly as the productions of the facile pencil which had already illustrated the works of Rabelais and the "Wandering Jew." A more European fame was attained by his illustrations of Dante's "Inferno," "Don Quixote," the Bible, La Fontaine's "Fables," Tennyson's "Idyls," Milton's works, Coleridge's "Ancient Mariner," and a series of drawings entitled "London." Doré's chief talent lay in depicting the weird, the ghastly, the titanic, and things grotesquely comical; and this he knew well enough, for his very talk was all in superlatives, fanciful comparisons, paradoxes, and merry conceits. When the moody fits were upon him—and he was most liable to these in rainy weather—he was obstinately taciturn, and relieved himself by drawing the most dismal things—scenes of carnage, torture, suffering, and the like; but he was never, in any of his moods, either serenely grave or idyllic. His figures are rarely remarkable for beauty of form or feature; the simply graceful seems to have been usually beyond his ken.

DORE'MA. See AMMONIAC.

DOR'IA, ANDRE'A, was born in 1466 at Oneglia, in the western Riviera of Genoa. Having lost his parents at an early age, Doria embraced the profession of arms, and served under several princes in various parts of Italy. Genoa had been for a long time distracted by factions, which had brought it under the dominion or protection, as it was styled, of the Visconti and Sforza, dukes of Milan, and under the French when Francis I. of France had conquered Milan. With the good-will of the Emperor Charles V. Doria gathered together fifteen galleys, and with this little squadron appeared before Genoa in 1528, and being favoured by the inhabitants, he obtained possession of the city and drove the French away. Doria then reorganized the government of the republic, and was himself appointed censor for life, with the title of "Father and Liberator" of his country. He now resumed his naval career as admiral of Charles V., and distinguished himself against the Turks and the Barbary pirates. He escorted Charles V. to the expedition of Tunis in 1535, and contributed greatly to the taking of the place; and in 1541 he commanded the fleet in the expedition of Charles V. against Algiers, from which he is said to have tried in vain to dissuade the emperor. It turned out as he had foreseen, and he could only save the emperor with a small part of the army. In his old age Doria retired to Genoa, where he lived in great splendour and reputation. At the beginning of 1547 his life was threatened by the conspiracy of Fieschi, who, however, perished in the attempt. In 1552 Doria, then eighty-five years old, went to sea again to attack his old enemies the Turks, but little was effected, and in 1556 he resigned his command to his nephew, Gian Andrea Doria, who was confirmed as admiral by Philip II. Andrea Doria died in his palace at Genoa in November, 1560.

DO'RIAN MODE, in music, is that one of the ancient Greek scales which is our scale of D played entirely on white notes of the pianoforte (D E F G A B C D) with the

peculiar minor Seventh characteristic of ancient Greek music. The Hypodorian mode, a variety of the Dorian beginning a fourth below the key-note (A to A on white notes), gave notes each side of the "firm, manly, and severe Dorian," and did not inflict so severe a strain on the voice. Only modern "high tenors" could sing much in the Greek Dorian mode, and it is not to be wondered at that Hypodorian was the more favourite variety. So much was this the case that our present nomenclature is derived from it; for the first scale, that beginning with A, is naturally in the true Greek Hypodorian mode (A B C D E F G A) on pianofortes and organs to this day.

The ecclesiastical musical system of the middle ages used the Greek names for the very different modes or tones then in use. In this particular case of the Dorian mode, Greek and ecclesiastical scales are alike, but this is the only point in which they coincide. See GREEK MUSICAL SYSTEM; MODES, ECCLESIASTICAL.

DO'RIANS, the most powerful of the Hellenic tribes, derived their origin from a mythical personage named Dorus. Herodotus mentions (i. 52) five successive migrations of this race. Their first settlement was in Phthiotis, in the time of Deucalion; the next, under Dorus, at the foot of Olympus; the third on Mount Pindus, after they had been expelled by the Cadmæans from Olympus. The fourth settlement of the Dorians was in Dryopis (afterwards called the Dorian Tetrapolis); and their last migration was to the Peloponnesus. The migration of the Dorians to the Peloponnesus, which is generally called the return of the Heracleidæ (descendants of Hercules), is stated to have occurred eighty years after the Trojan War, *i.e.* in 1104 B.C. (Thucyd. i. 12.) The origin and nature of the connection which subsisted between the Heracleidæ and the Dorians are involved in obscurity.

The government which the Dorians established in all the countries which they invaded and conquered was an aristocracy; for while the successful invaders remained on a footing of equality among themselves, all the old inhabitants of the country were reduced to an inferior condition. They were called *περίοικοι*, or "dwellers round about the city," a name corresponding exactly to the Pfahlbürger, or "citizens of the palisade," at Augsburg, who dwelt in the city suburbs without the wall of the city; to the "pale" in Ireland before the time of James I.; to the people of the contado in Italy; and to the fauxbourgeois in France. The constitution of Sparta in particular was an aristocracy of conquest, as far as the relations between the Spartans and Helots or original Lacedemonians were concerned, while the Spartans themselves lived under a democracy with two head magistrates, who were indeed called kings, but possessed very little power.

In addition to the Dorian settlements in the Peloponnesus, this race sent out many colonies; of these the most important were established along the south-west coast of Asia Minor. Rhodes, Cyprus, Corcyra, and Sicily also had a Dorian population; Byzantium and Chalcedon were Megarian colonies; and the celebrated cities, Tarentum and Crotona, in Southern Italy, were founded under the authority of Sparta.

DO'RIC ARCHITECTURE. See GREEK ARCHITECTURE.

DO'RIC DIALECT, a variety of the Greek language peculiar to the Dorian race. It was spoken in the Dorian Tetrapolis; in the greater part of the Peloponnesus; in the numerous Dorian colonies in Italy, Sicily, and Asia Minor; in Crete, Ægina, Rhodes, Melos, Corcyra, and Cyrene. As a written language it is divided by grammarians into two classes, the old and new Doric. In the former Epicharmus, Sophron, and Alcman wrote; in the latter, Theocritus, Bion, and Moschus. The lyric poets in general wrote in the Doric dialect, but Pindar wrote a language based upon the epic or Ionic dialect, with a liberal use of Doric and Æolic forms. The existing monuments of the pure Doric, in addition to the fragments of the old writers which have been collected, are the specimens in the comedies of Aristophanes, the treaties and decrees quoted by the Athenian historians and orators, and the inscriptions collected by Chandler, Mustoxidi, and Boeckh. The characteristic of the Doric is a certain rugged archaic simplicity, a complete contrast to the exquisitely polished Attic or the soft Ionic.

DO'RIDÆ. See SEA-LEMON.

DOR'KING or **DARKING,** a market-town of England, in the county of Surrey, 29 miles S.W. by S. of London, on the Brighton and South-eastern railways, finely situated on the southern slope of the North Downs, almost at the base of the green height of Box Hill, and on a small stream, the Pip Brook, which flows immediately into the Mole. It is a clean, quiet, and healthy town, and well paved, with some good old houses, and a market which is still famous for poultry. During the last few years many new and handsome villa residences have been erected, the occupiers having been attracted by the railway facilities and the beauty of the neighbourhood. The Dorking fowls are a peculiar breed, distinguished by their five claws, fine flavour, and abundance of eggs. The parish church was entirely rebuilt in 1866–74, and is a very handsome edifice. There are several other modern churches, some denominational chapels, a good town-hall, and some almshouses. In the neighbourhood are some of the finest landscapes in Surrey; groves, brooks, woodland glades, fine bold hills and rich valleys, with a great number of parks and gentlemen's seats. The population in 1881 was 9577. The area of the parish is 10,150 acres. The custom of borough English, by which the youngest son succeeds to copyhold property, prevails in this manor. The Sussex Roman road formerly passed close to Dorking.

DOR'MER WINDOWS are those which are pierced through a sloping roof and placed under a small gable roof of their own.

DOR'MOUSE, the general name of a family (Myoxidæ) of RODENTIA, forming a group intermediate between the squirrels and the mice. The molars are sixteen in number, furnished with fangs, and have their crowns marked with transverse ridges of enamel. The feet are provided with five toes, but the fifth toe of the fore foot is merely represented by a rudimentary tubercle or warty excrescence. In this family alone of the Rodents is the intestine devoid of a cæcum. The ears are rounded and oval, and the whiskers well developed. The fur is particularly soft and fine. The tail is very long, hairy, and more or less tufted at the extremity. The food of the dormice consists principally of vegetable matters; but they also devour beetles, and have been known, in a state of confinement, to eat bats, and even their own young. The family contains only two genera, Myoxus and Graphiurus, both confined in range to the Old World, and the latter confined to Africa. The genus Myoxus is represented in England by the Common Dormouse (*Myoxus avellanarius*). This well-known little animal, with its ruddy yellow fur, is a great favourite with those who delight in domesticated animals, in which condition it is particularly gentle and docile. It is tolerably common throughout Europe, and dwells in the sequestered parts of dense thickets and plantations. In its habits it somewhat resembles squirrels—climbing branches and feeding on nuts, acorns, berries, and the like. The name dormouse (Lat. *dormire*, to sleep) has reference to its habit of hibernation. During the summer it lays up a store against the winter, when it falls into a drowsy and torpid state; but on warm sunshiny days it sometimes emerges from its snug retreat or dormitory. Its habits are nocturnal. In the spring the female usually produces four young, which are blind at the time of birth. A second brood is occasionally brought forth in the early part of autumn.

The Loir (*Myoxus glis*) is an inhabitant of Southern Europe, being also found in Georgia and on the borders of the Volga. It is about 6 or 7 inches in length, and has a pale ash-coloured fur, which is white underneath the belly and at the inner sides of the limbs, the eyes being surrounded by a dark-brown circle. It has a bushy, squirrel-like tail. This animal was in early times highly prized as a dainty, and was kept by the ancients and fattened in separate hutches expressly for the table. It nestles in holes of trees and rocks, and sometimes attacks small birds. The Garden Dormouse (*Myoxus nitela*), another species of Southern Europe, is intermediate in size between the two preceding species. It dwells commonly in gardens, committing great havoc among fruits.

DOR'NOCH, a parliamentary burgh and maritime town of Scotland, in the county of Sutherland, situated on a frith of the same name, 14 miles N. of Cromarty. It is the only burgh within the county, and joins with Wick, Kirkwall, Tain, Cromarty, and Dingwall in returning one member to the House of Commons. The place was formerly the seat of the bishops of Caithness, part of whose palace is still entire and used for county purposes; the old cathedral of the diocese, which stood here, after being burned during the feuds of the sixteenth century, and repaired at different subsequent periods, was ultimately rebuilt in its present form, but unfortunately retains few of the features of the old edifice. Dornoch derived its origin from being the seat of the bishopric. Being without trade or manufactures, it is a small town, and important only as the county town. The last burning of a witch took place here in 1722. The population of the burgh in 1881 was 2525. Near Golspie, 12 miles N.N.E., stands the vast pile of Dunrobin Castle, one of the seats of the Duke of Sutherland, of which the high towers and fretted pinnacles, in the style of a foreign chateau, are the conspicuous external features.

DORNOCH FRITH extends inland for about 25 miles from the North Sea, and at its entrance, between Tarbetness and Dunrobin, is about 11 miles wide. The navigation is impeded by sandbanks, but vessels up to 600 tons burden can enter at high water. The upper part of the frith is called the Kyle.

DOR'PAT or **DORPT** (in Livonian, *Tehrpata*), the chief town of the circle of Dorpat, in the Russian government of Livonia, stands on the Great Embach, which is here crossed by a fine granite bridge, about 140 miles N.E. from Riga, and has 22,000 inhabitants. The town is built in the form of a semicircle; it is laid out in straight broad streets, and contains some handsome public buildings of freestone, particularly the government offices and university buildings. It is the winter residence of many of the Livonian gentry. On an eminence at the north-west of the town stand the famous observatory of Dorpat, the buildings of the university library, and the medical school. The main support of the town is derived from internal trade, for which the Embach affords great facilities, and from the university students. A large fair is held in January for the sale of Russian and foreign manufactures. The university was founded by Gustavus Adolphus in 1632, when Livonia belonged to the Swedish crown; it was reconstituted in 1802 by the Emperor Alexander, for the benefit of Livonia, Esthonia, and Courland. It has forty-two professors, and consists of the four faculties of theology, law, medicine, and philosophy. In connection with it there are a library of 250,000 volumes, collections of mineralogy, zoology, anatomy, philosophical apparatus, &c., a botanical garden, and several schools. Dorpat is said to have been founded in 1030. The town was almost entirely burned down in 1777.

D'ORSAY, COUNT ALFRED, son of General D'Orsay, was born at Paris in 1798. At an early age he entered the French service, and while stationed as a lieutenant at Valence, became acquainted with Lord Blessington, whose daughter by his first wife he married in 1827. Lord Blessington dying at Paris in 1828, the peerage became extinct. His countess (the second Lady Blessington) became a star in the literary firmament of England; and Count D'Orsay, having obtained considerable Irish property from his marriage, assumed in England the career of sportsman, dandy, artist, and general *arbiter elegantiarum*, and few men in his position showed greater accomplishments. It was in England that the count became acquainted with Prince Louis Napoleon; and soon after the arrival of the prince in France, D'Orsay fixed his own residence in Paris. The president of the republic had not a more devoted and sincere friend than D'Orsay. He became superintendent of fine art, but the appointment was only announced a few days before his death, which took place in August, 1852.

DOR'SET, EARL OF, Charles Sackville (1637–1706) was one of the licentious "wits" of the dissolute court of Charles II., but of such excellent literary taste that Dryden introduces him as a character (Eugenius) in his dialogue "Essay on Dramatic Poesie;" and whose reputation is well earned by the delightful light-hearted ballad which he wrote on board his ship the night before an engagement in the Dutch war, 1665:—

> "To all you ladies now on land
> We men at sea indite,
> But first we'd have you understand
> How hard it is to write."

Dorset aided the Revolution, and became lord chamberlain under William III., when he nobly used his power to defend the aged and poor Dryden, whose Roman Catholic faith would not permit him to take the required oaths of allegiance and supremacy.

DOR'SETSHIRE, an English county, bounded E. by Hampshire, N. by Wiltshire, N.W. by Somersetshire, and W. by Devonshire; along all its southern borders it is washed by the English Channel. The greatest length, from E. to W., is about 55 miles; the greatest breadth, from N. to S., is about 35. The area is 980 square miles, or 627,265 acres. The population in 1881 was 97,298. A detached part of the county is wholly surrounded by Devonshire.

Coast, Surface, Hydrography.—At the eastern end of Dorsetshire the coast is precipitous; but the cliffs soon decline, and are succeeded by the sandy inlet of Poole Harbour, which receives several streams, has some smaller bays within it, and several islands, the largest of which is Branksea. There is an alternation of sea-cliffs and low sandy shores westward of Poole Harbour, diversified by the bays or inlets of Studland, Swanage, Durlston, Kimmeridge, Worbarrow, Weymouth, Lulworth, and Ringstead; and by the points or headlands of Handfast, Peverel, Durlestone, and St. Alban's Head (344 feet high).

Portland Isle, which bounds Weymouth Bay on the S.W., is not strictly an island, but is attached to the mainland by a long ridge called the Chesil Bank. Portland is about 4 miles long by 1½ broad. The highest point is 358 feet above the level of the sea, and many of the cliffs are bold and lofty. The soil and herbage are both good, but the fertility is not great, and there are but few trees. There is one village, Chesilton, and several hamlets. There are two castles, Portland and Bow-and-Arrow. The Chesil Bank, which joins the island to the mainland, and which is about 16 miles long, is a ridge of pebbles resting on blue clay, in no place more than a quarter of a mile in width, and rising from 20 to 30 feet in height. Between a portion of the Chesil Bank and the mainland is a narrow arm of the sea called the Fleet, which is in no place more than half a mile in width.

The surface of the county is for the most part uneven. The principal elevations are the Chalk Downs, which,

entering Dorsetshire from Wiltshire on the northern side of Cranbourne Chase, turn to the south, and run to the valley of the Stour, in the neighbourhood of Blandford. From the valley of the Stour the Chalk Downs run nearly west to the neighbourhood of Beaminster, and form the north boundary of the basin whose drainage is received by Poole Harbour. Some of the hills reach an elevation of 800 or 900 feet. From Beaminster they run south-east, and form the South Downs, the highest points being along the southern escarpment. Pillesden Pen, the loftiest of these hills, is 934 feet high.

The Stour, the chief river of Dorsetshire, rises in Wiltshire, and passes through Sturminster, Blandford, and Corfe Mullen, into Hampshire; it receives the waters of the river Shreen, Lidden, Cale, Allen, and Avon. The Yeo, Ive, or Ivel flows from Milbourne Port, and traverses a very small part of Dorsetshire. The Piddle and the Frome, coming from different parts of the county, unite near Wareham, and flow into Poole Harbour. The western part of the county is watered by the Bredy, Brit, Char, and Axe. It is well supplied with railway accommodation by means of the London and South-western, the Wilts and Somerset division of the Great Western, and the Somerset and Dorset lines. A breakwater of gigantic proportions and immense strength has been formed from the Isle of Portland to convert the bay of Weymouth into a harbour of refuge. There is also a railway from Portland to Weymouth.

Geological Character.—The North and South Downs inclose a basin, the "Trough of Poole," in which are the formations overlying the chalk; beyond or without this basin are the formations which underlie the chalk. The eastern parts of the county are mostly occupied by the plastic clay. Potters' clay, in beds of various thickness and at different depths, alternates with loose sand in this formation in the Trough of Poole. It is sent to Staffordshire, where it is mixed with ground flints, and employed in the finer kinds of pottery. Beneath the potters' clay lies a seam of very friable earthy brown coal, somewhat like Bovey coal. An extensive horizontal bed of pipe-clay skirts the northern declivity of the South Downs. The plastic clay is found capping one or two hills south-west of Dorchester. The chalk formation bounds the plastic clay. In the North Downs the chalk occupies a breadth of nearly 10 miles, and at its western extremity it is still broader. On the southern side of the Trough of Poole it becomes much narrower, merely averaging 2 miles in breadth. The cliffs along the south coast are partly chalk. The valleys drained by the upper part of the Frome and its tributaries are occupied by the green-sand. The chalk-marl, green-sand, weald-clay, and iron-sand skirt the chalk in the Isle of Purbeck, and extend along the coast between the chalk and the Purbeck and Portland limestone.

The Purbeck strata, belonging to the upper series of the oolitic formation, consist of argillaceous limestone alternating with schistose marl; they crop out from under the iron-sand in the Isle of Purbeck. A variety of the Purbeck stone, known as Purbeck marble, was formerly much used in building. The Portland oolite, another member of the same series, which succeeds the Purbeck stone, occupies the remainder of the Isle of Purbeck and the whole of that of Portland. It consists of a number of beds of a yellowish-white calcareous freestone, generally mixed with a small quantity of silicious sand. The varieties of this formation afford the greater part of the stone used for architectural purposes in London. In the Portland quarries the saleable stone occupies layers or strata situated several feet beneath the surface. The thickness of workable stone varies from 7 to 16 feet.

Climate and Agriculture.—The climate of Dorsetshire, though mild and healthy, is not so warm as its geographical situation would lead us to expect, a circumstance which is owing to the nature of the soil and the bareness of its chalk hills, there being little or nothing to break the force of the winds. The air is keen and bracing, rather than soft and warm.

The whole surface of the county consists chiefly of loose sand and gravel, clay, and chalk. The most fertile spots are those where all the three have been mixed in the valleys by the rivulets which run down the hills carrying the soil with them. The poor sandy soil occupies that part of the county which joins Hampshire. Near the coast is a stratum of clay over the chalk. On the light chalky soils turnips have been very generally introduced. The introduction of sainfoin on the dry chalky soils has been a great advantage, as it produces a rich fodder, requires little manure, and lasts many years. Wheat, barley, oats, and beans are grown in various parts of the county, and potatoes are cultivated to a considerable extent in the rich loams about Bridport, Beaminster, Abbotsbury, &c., but from the nature of much of the soil, grazing, the dairy, and sheep farming are generally found more profitable than tillage. The meadows along the vale of Blackmore are extremely rich, and produce much hay, which is used to feed the dairy cows in winter. The hill pastures are not rich enough to fatten oxen, but are well adapted to feed dairy cows.

The general state of agriculture throughout the county is very good, but although some advance has recently been made in this respect much remains to be done with regard to the improvements in the condition of the farm buildings and labourers' cottages. According to official agricultural returns published in 1888 there were 490,000 acres under cultivation in the county, of which 105,000 were devoted to corn, 60,000 to green crops, and 270,000 to permanent pasture.

The live stock of the county at the same time was 80,000 head of cattle, 480,000 sheep, and 50,000 pigs. Great care is taken in the selection of stock in Dorsetshire, and in proportion to its extent the county contains a larger number of milch cows than any other in England. The cows are chiefly varieties of the Devonshire breed. The Dorset butter is in good repute in London and Portsmouth for ship provision as well as domestic use. The skimmed milk is made into cheese, which is preferred on account of the streaks of blue mould which run frequently through it. Dorset sheep are noted as a profitable breed.

Manufactures.—The manufactures of Dorsetshire are not of any importance, being almost entirely confined to articles of local use. Portland stone is largely quarried for building purposes, and so also are Purbeck marble and other limestones. Much potters' clay is also obtained, the quantity in 1888 having been officially returned as 100,000 tons. Most of it is shipped at Poole and Bridport to various parts of Great Britain, but chiefly to Runcorn and London. There are some profitable mackerel fisheries at Weymouth.

Divisions, Towns, &c.—Dorsetshire is divided into nine divisions, which are subdivided into thirty-five hundreds and more than 300 parishes. It is in the diocese of Salisbury, and in the western circuit. The assizes and quarter sessions are held at Dorchester. Four members are returned to Parliament for the county, and the former parliamentary boroughs of Weymouth, Bridport, Dorchester, Poole, Shaftesbury, and Wareham were disfranchised in 1885.

History and Antiquities.—The county was, in the earliest period noticed by history, inhabited by a people whom Ptolemy calls *Durotriges*, who are believed to have been a Belgic race. Upon the conquest of South Britain by the Romans Dorsetshire was included in Britannia Prima. Of this early period there are several remains in various camps and earthworks, stone circles, cromlechs, and barrows, especially Maiden Castle, which is the noblest example of an ancient British town in existence.

In the north-eastern part of the county and the adjacent part of Wiltshire there are several embankments with ditches; they all run in a winding and irregular manner, mostly from the south-east to the north-west, having the ditch on the north-east side. There are several Roman camps in the county, and the walls and amphitheatre of Dorchester, and the coins and pavements found there, are monuments of the same victorious people. Two or three Roman stations have also been found in the county, and several roads, of which the chief was the Ikenield Way.

Under the Saxons Dorsetshire was included in the kingdom of Wessex, and after the West Saxon princes acquired the sovereignty of England they resided occasionally in this county. By the invasions of the Danes it suffered severely, especially in 1002, when Swegen, king of Denmark, destroyed Dorchester, Sherborne, and Shaston or Shaftesbury. Throughout the middle ages few events of historical interest connected with the county occur. In the civil war of Charles I. the gentry were mostly for the king, but the people of the towns and of the ports were for the Parliament.

It is a strange circumstance that although the county has passed through so many changes in its inhabitants, it yet retains in its name the Celtic root-word *Dwr*, meaning water. This word appears in the title *Durotriges*, water-dwellers, and in the first syllable of the present name, Dorset.

DORSTE'NIA, a genus of plants of the order URTICACEÆ. The roots of *Dorstenia Contrayerva* and other species of this genus are all confounded under the appellation of Contrayerva root, which is recommended in the low stages of fever, especially of children; it has stimulant and tonic properties. This genus is closely allied to mulberries and figs. The receptacle on which the flowers grow does not inclose them, as in the case of the fig, but is flat and roundish or lengthened out. There is no perianth in either male or female flowers. The species are natives of tropical America.

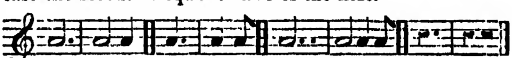
DORT or **DOR'DRECHT**, an ancient city, once the capital of the Dutch province of South Holland, is situated on an island formed by the Maas, 10 miles south-east from Rotterdam, and has a population of 25,000. It has a good harbour, and great facilities for trade. By means of canals goods are conveyed into the heart of the city. The principal trade is in corn and wood, large rafts of which are brought down the Rhine and broken up for sale. There are many saw-mills in the town. Shipbuilding also forms an important branch of industry, and there are salt and sugar refineries, bleaching works, and manufactures of tobacco and white lead. The old church, the town-hall, and the *Kloveniers Deolen* Inn, in which the Synod of Dort was held, are the most interesting buildings.

Dort was one of the first towns in Holland to receive the Reformation and to rebel against the Spanish rule. In 1572 an assembly held here resulted in the foundation of the republic of the United Dutch Provinces. A great synod of theologians, convened in 1618 and 1619 to settle the differences between the followers of Calvin and Zwingli, is famous under the name of the Synod of Dort.

DORT'MUND, a town in the Prussian province of Westphalia, is situated on the Emscher, and has 67,000 inhabitants. It is an old ill-built place, surrounded with a wall which has five gates, but it has some fine religious edifices. There are considerable manufactures of linen, nails, tobacco, and beer, and also an extensive trade in corn and colonial produce. It is a point of junction for five railways, and has several factories for railway material employing a large number of hands. The Vehmgericht, a celebrated secret tribunal, was founded in Westphalia after the fall of Henry the Lion, at a time when anarchy and lawlessness prevailed throughout Germany, and in the fourteenth and fifteenth centuries had extended its sway over the whole empire. The number of the initiated, bound by the most fearful oaths to execute the decrees of the tribunal, is said to have exceeded 100,000. In Westphalia alone the Freigraf, or president, was privileged to hold meetings for receiving new members. Dortmund was the seat of the supreme court, and here, in the Königshof under the Linden, the Emperor Sigismund was himself initiated in 1429. Latterly, however, the tribunal degenerated into little more than a police court, before which the inhabitants of Dortmund and the neighbourhood carried their grievances. The last meeting held by this society here was in 1803.

DO'RY (Zeus), a genus of fishes, forming together with the genus Cyttus a subfamily of the Scombridæ or MACKEREL family. The fishes of this group have very protractile mouths, armed with feeble and not numerous teeth. Their skin is either naked or clothed with small scales imbedded in the skin, and sometimes carrying small, bony, spiny shields along the bases of the fins or elsewhere. Their bodies are high and compressed, and are surmounted by one or two dorsal fins. They are marine forms, and inhabit the temperate zone of the northern and southern hemispheres. In the genus Cyttus the body is covered with small scales. It is confined to Australia, New Zealand, and Madeira. In the genus Zeus a series of bony plates runs along the base of the dorsal and anal fins, and another series on the abdomen. It is found in the Atlantic and the Mediterranean, and extends into the seas of Japan and Australia. The John Dory (*Zeus faber*) of the British coasts is a well-known form. Its body is high and compressed, the tail short, and its back fin long and slender. The dory is frequently captured with the haddock, and has long been an object of popular interest, from the legend that the black spots on each side are the marks of St. Peter's hand when he went to the shore to get the piece of money for the tribute. The John Dory is in high repute gastronomically. Dr. Gunther suggests that the first part of its English name is a corruption of the Gascon *jau*, meaning cock, adding that in some localities of southern Europe it bears the name of Gallo. The same authority derives Dory from the French *dorée*, gilt.

DOT, in music, a point placed after a note or rest, in order to make such note or rest half as long again. In modern music a double dot is occasionally used, in which case the second is equal to half of the first.



Dotted notes and rests and their equivalents.

DOT'TEREL (*Charadrius morinellus*), a species of PLOVER, is a summer visitor to this country. It measures about 9½ inches in length; its plumage above is ash colour, variegated with brown and buff; the head is brown, with a white streak on each eye; the breast is fawn colour, with a white transverse band, and the belly black. The dotterel breeds in the high latitudes of Europe and Asia, migrating in the summer as far south as the Mediterranean. It sometimes breeds on the high grounds of the northern parts of England and Scotland. It lays three or four eggs in a small hollow in the ground; its food consists of worms, insects, and slugs. This bird is much esteemed for the table.

DOU, GERARD, was born at Leyden in 1613. He studied drawing under Bartholomew Dolendo, and was afterwards instructed by Peter Kouwhoorn, a painter on glass, and then by Rembrandt. From that great painter Gerard learned the mastery of colour and chiaroscuro, but he differed entirely from his teacher in his manner of painting. Instead of growing bolder and rougher in his handling as he grew older, he became more and more delicate in his work, delineating every thread in a texture and every hair in a beard almost. He was among the most

careful of painters over his materials. He made his own brushes and ground his own colours, prepared his own varnish, and had a ditch dug outside his studio to avoid the dangers of dry dust. As a consequence his pictures are as bright as the day he finished them. His portrait by himself, with a pipe in his hand, in the National Gallery, is a truly delightful work of art. One is tempted to regret the pains spent over minute details, but nevertheless it is impossible to behold Dou's work without the highest pleasure. He died, much honoured, in 1675. All the great collections of Europe have fine examples of this master.

DOUAI, a large, ancient, and important town on the Scarpe, in the French department of Nord, stands at a distance of 80 miles south-west from Brussels, and 149 north by east from Paris by the railroad which joins those cities, and had 24,720 inhabitants in 1882. It is surrounded by ancient walls, flanked with towers and laid out in agreeable promenades. The town is further defended by a strong fort on the left bank of the Scarpe. The streets are well laid out. The town-hall, the church of St. Pierre, the cannon foundry, and the arsenal are the principal buildings. The inhabitants are chiefly engaged in the manufacture of linen, lace, thread, gauze, cotton, soap, glass, leather, beer, gin, pottery, paper, oil, chemical products, and refined sugar. A considerable trade is carried on in corn, wine, brandy, chicory, wool, hops, flax, woollen cloth, and cattle. Douai is the seat of a high court which has jurisdiction over the departments of Nord and Pas de Calais; it has a college, a school of artillery, a school of drawing and music, a public library (which contains 40,000 volumes), a museum of natural history, a botanic garden, and a collection of paintings and antiquities, several hospitals, and a theatre. The English college founded by Cardinal Allen is now used as cavalry barracks. The commerce of the town is more active than formerly, in consequence of its connection by railways with the chief towns of France and Belgium. Douai has also extensive communication by means of the Scarpe, which falls into the Schelde, and by numerous canals that connect it with the principal trading towns of France, Belgium, and Holland.

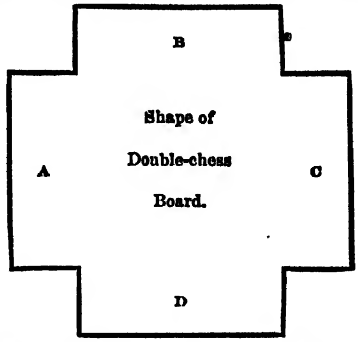
DOUAY BIBLE, the name given to the English version of the Scriptures used by Roman Catholics, from the Old Testament portion of it being first printed at Douay, or Douai, 1609–10, though the New Testament had been already printed and published at Rheims in 1582. Both were prepared by Roman Catholic exiles in the English college founded in 1568 by William Allen (afterwards cardinal), and were taken from the Vulgate. The Douay Bible is the standard English version for the Roman Catholic Church. As a sample of the differences in translation it may be mentioned that "repentance" in the Authorized Version is usually "penance" in that of Douay.

DOUBLE, in music, is used to express a doubled sign, as *double bar* [see BAR], *double sharp*, *double flat* [see SHARP, FLAT]. Or it expresses a twofold nature, as *double counterpoint*, which is an invertible counterpoint usable to accompany the melody to which it is written, either above it or below it, as desired [see COUNTERPOINT]; and *double fugue* [see FUGUE]; or a doubled instrument, or set of parts, or form of composition, as DOUBLE FLUTE, DOUBLE CHORUS, DOUBLE CHANT.

Or it expresses instruments sounding an octave below those of a certain standard, the doubles being of course of larger size, as *double bass*, *double bassoon*, *double diapason* [see CONTRABASSO, CONTRA-FAGOTTO, DIAPASON], respectively giving tones an octave below the bass-viol or violoncello, the bassoon or fagotto, and the chief stop of the organ, the 8 feet diapason. (The double diapason is 16 feet, which means that the extreme bass pipe, C C C, is 16 feet in length.)

DOUBLE CHANT, a chant for two complete verses of the Psalms. See CHANT.

DOUBLE CHESS differs from chess (single chess) chiefly in its being played by four people. An ordinary chessboard of eight squares to a side being extended each



way three squares deep a cruciform outline is obtained, as in the above figure. The players play a wooden set against an ivory set, and partners are opposite each other, as in whist. Let A in the figure have yellow wood men, then C his partner will have black wood men; if B has red ivory men, then D his partner will have white ivory men. The pieces will occupy the two outside rows as usual, then it will be found that each set of men has one row in front of it before being "clear of the corner," that is, the partners are at ten rows' distance at starting. The board measures fourteen rows from side to side. Players draw for starting. If A wins the start he plays; he is then followed by his opponent B, then comes his partner C, and finally B's partner D; A then begins the next turn. It is manifest that the attack of A may be directed either against B or D; and if two partners perceive their common interest (of course without communication, which is as much forbidden as in whist) and unite to fall upon one of their opponents, their two moves against his one may soon crush him if *his* partner does not swiftly attack one of them in rear and draw him off. Games usually succeed in this way, however; and one of the opponents being checkmated either by one or partly by each of the partners, he and his pieces are for the time dead and simply fill up the squares of the board they occupy. The object of the victorious partners is now to crush their remaining opponent. He on his side will strive to protect himself, but even more than this he will endeavour to threaten the mating pieces or to take them, so that the checkmate of his partner may be annulled, whereupon instantly the partner comes to life again and takes his usual turn. This not unfrequent occurrence is startling in its results, for the dead pieces have been so long neglected that the former conquerors are usually exposed to the direst woes from having put themselves in the line of fire here and there. The game lacks the majesty and the intellectual nature of chess; but on the other hand it is far pleasanter as a recreation, is not at all exhausting in its demands upon the brain, is provocative of mirth, and is as interesting to the bystanders as to the players from its incessant surprises; and finally, long waits between the moves are never taken by good double-chess players (except at some tight pinch of the mimic battle), because the three succeeding moves which have to pass before the player's next turn comes make it useless for him to look more than a move or two ahead. While, therefore, chess is the grander game, double chess is the more amusing. The moves of the pieces are as in single chess, except as to the pawns. These have not the power of the double move at first, as in ordinary chess, but can only step one square. When

they are clear of the corner (*i.e.* at the second or subsequent move) they may turn to the right or to the left, or if they take a piece in the usual oblique fashion, their taking either to right or left determines their "facing." Thus A's pawns may travel forwards towards C as long as is thought well, but one of them once having either moved or taken towards B, for example, it must continue to move and take towards B, and is quite powerless towards D. The end pawn can thus (if unopposed) "queen" in five moves, a valuable power at the close of the game. The knight's power is greatly lessened in double chess. The queen's power is greatly enhanced, the long stretches of the board giving her a surprising advantage. The kings of all four players are put upon a white square, the queens upon a black. Otherwise the pieces are arranged as usual.

If there is any difficulty in procuring a double-chess board, it is quite easy to make one out of three equal paper or cardboard chess-boards, such as are everywhere sold, using one as the centre and adding from the others three rows to each side of the first, fastening the whole upon a suitable background.

DOUBLE CHOIR, DOUBLE CHORUS. A double chorus (or choir) must be distinguished altogether from an eight-part chorus (or choir). The latter divides the usual four parts of the vocal quartet (soprano, contralto, tenor, and bass) each into an upper and a lower part; thus we have first and second soprano, first and second contralto, &c. All the eight parts sing simultaneously, as in Mendelssohn's masterpiece, the forty-eighth Psalm, "Judge me, O God." But in a double chorus, as in Handel's almost unequalled double choruses in "Israel in Egypt," the parts are left equal, and the whole choir is divided in two. Thus we get a first choir and a second choir, who challenge and answer each other and occasionally join together. The CANTORIS and DECANI sides of a cathedral choir are a familiar example of a double-choir arrangement, though the music they sing being simple alternation, without musical contrast, is not to be called double chorus. Here we see each choir contains the complete single vocal quartet. Antiphonal or alternative effects are those aimed at in true double choruses. Next to Handel the finest are Wesley's motet, "In exitu, Israel," and some of Bach's motets, as "Sing ye," &c.

DOUBLE CONSCIOUSNESS is the name given to a morbid mental condition in which the idea of personal identity is more or less confused and uncertain. In its milder forms it appears to be allied to that state of mind which is reached in somnambulism and hypnotism, under which influences a person may smell, taste, hear, see, think, and act, and yet retain no recollection of what has taken place when he awakes, though the memory will return with a renewal of the peculiar condition. There have been, however, cases of a stronger type in which the individual affected has appeared to have been conscious of two independent trains of thought at the same time, and has imagined himself to consist of two distinct persons. In the fifth annual report of the Crichton Royal Institution, 1844, an account is given of an insane patient in whose case the delusion was so complete as to lead him to imagine a conflict was taking place between his two selves, and to severely beat his body with his hands under this impression. Usually the disease takes the peculiar form of two interwoven lives; and the patient when in his first state has no memory of anything done in his second state, recognizes no friends made in that state, is ignorant of languages or accomplishments which he perfectly well knows in the second state, &c. After an interval curiously regular in some patients, irregular in others, the first state gives way to the second, and it is now the turn of the actions, thoughts, and facts of the first state to pass into complete oblivion. Several cases have been described in detail, and have been found to present grave difficulties only at times of transition, when much confusion naturally occurs. The subject is well treated in M. Taine's work "De l'Intelligence" (third edition, Paris, 1878). There is a good English translation by Haye (London, 1871).

The cause of this rare and peculiar mental condition is unknown. It has been referred to the supposed independent action of the two hemispheres of the brain, and by another theory it is derived from what has been called "unconscious cerebration," but neither explanation has been accepted as sufficient by physiologists up to the present. See CEREBRATION, UNCONSCIOUS.

DOUBLE FLUTE (or more probably in reality double clarinet) was the principal instrument among the ancients for giving chords. The lyre seems only to have been used string by string, but the bagpipe and the double flute always sounded two notes at once; and the latter, since both notes could be varied, was by far the superior instrument. Sometimes the two tubes had a common mouthpiece, sometimes they were quite distinct throughout, with distinct mouthpieces. The "male pipe," as it was called, gave the bass note, and had three holes; it was played with the right hand. The "female pipe," for the left hand, had four notes, and played the treble of the harmony. Sometimes the pipes were of equal length, but more often, as may be imagined, the "male pipe" was the longer. The player of the double flute, usually a woman, generally assisted herself to maintain even and gentle blowing by the CAPISTRUM, a leather band encircling the cheeks, pierced to admit the mouthpieces of the pipes. Double flutes, &c., are not now used among musical nations in Europe; but the peasantry in Russia to this day construct a rude harmony with their *dutka*, a double shepherd's pipe.

DOUBLE REFRACTION. Many crystals possess the power of double refraction; that is, of dividing a ray of light into two parts, which are found to be oppositely polarized; as if one were to separate all the vertical from all the horizontal planes of a cube, or the warp from the weft of a piece of cloth. If this were all it would not be possible to detect the difference, since the divided rays issuing together would probably recombine. The peculiarity is that one of the half-rays is refracted a good deal more than the other, so that a single beam of light thrown on to a crystal of Iceland spar, for instance, issues as two beams of light travelling at a considerable angle, and of course manifesting opposite polarities. See REFRACTION, POLARIZATION, NICOL'S PRISM.

DOUBLES, in music, is the old term for what are now called variations. Thus the famous "Harmonious Blacksmith" of Handel is entitled "An Air with Doubles, by Mr. G. F. Handel," in old copies.

DOUBLET (Fr. *doublet*, from *doublé*, doubled), the name to a close, tight-fitting garment which was originally lined or wadded for defence. It was introduced into England about the middle of the fifteenth century, and continued to be worn until the reign of Charles II. Originally sleeveless, sleeves were afterwards made separate and tied on at the arm, and at a later period were sewn on in the usual way.

DOUBS, a department in the east of France, formed out of the old province of Franche-Comté, is bounded N.W. and N. by the departments of Haute Saône and Haut Rhin, S.W. and S. by the department of Jura, and E. by Switzerland. Its length from north to south is 66 miles, from east to west 60 miles. The area is 2018 square miles, and the population in 1886 was 310,963.

The department presents high mountains, forests, narrow valleys, heaths, rocks, marshes. It is crossed from north-east to south-west by four parallel chains of the Jura Mountains; in the highest of these, which runs along the Swiss frontier, are the summits Mont d'Or and Mont Suchet, respectively 4920 and 5248 feet high; the other

chains become successively lower, so that the highest point in the western chain, Roche d'Or, is only 2860 feet in height. The two more eastern chains have their sides clothed with pine forests, the perpetual verdure of which forms a strong contrast with the snows that cover the mountain tops during six months of the year, or, in the absence of snow, with the bare rocky crags which occupy the crests of these chains; on their southern slopes, however, there is good pasturage during the summer and autumn, to which numerous herds of cattle are driven; and here in the *châlets* or shepherds' huts (the only habitations met with in these parts) a great quantity of excellent butter and cheese is made. Even in the valleys of this region little attention is paid to the cultivation of the soil, in consequence of the length of winter, the depth of the snow, and the short continuance of the fine season. The only crop is oats, but even this is sometimes lost under the early snow. The other two chains, though they present many bare rocky heights, have a milder climate, forests of oak and beech instead of pine, and a more fertile soil in the valleys, which yield wheat, but in no great quantity; the vine is cultivated on sheltered spots facing the south. The west of the department, between the Doubs and the Oignon, is comparatively level, very fertile, and much more densely peopled than the highlands; here the hills are covered with vineyards, and the plains abundantly produce wheat, maize, hemp, flax, fruits, and other crops. The valleys which separate the mountain chains are longitudinal, that is, they run in the direction of those chains; they vary greatly in width, in some places opening out into tolerably wide basins, but frequently contracting into deep narrow gorges. The climate is cold but healthy in the mountainous districts, where the snow lies commonly from October till April. In the western plains the temperature is more genial; west and north-west winds are frequent, and bring rain, while the south-west is ordinarily violent and dry.

The production of bread-stuffs is not sufficient for the consumption; of wine the annual produce is not large; walnuts, cherries, and other fruit-trees are extensively cultivated. Horned cattle, resembling the Swiss breed, and horses are reared in great numbers. The rivers abound in trout, perch, tench, eel, carp, pike, crab, &c. Iron and coal mines, marble, gypsum, and building-stone quarries are worked; marl, fullers' and potters' clays are found; and peat for fuel is dug in many places. The mountain pastures abound with medicinal and aromatic plants, and of these large quantities are gathered.

In the mountainous districts the rearing of cattle and the making of cheese and butter are the chief occupations of the population; the annual value of the cheese made in the department is 1,650,000 francs, that of butter only 260,000 francs. The cheese is of good quality, and resembles Gruyère. Of manufacturing industry, properly so called, the products furnished by the department are—watch and clock movements, cotton and woollen cloths, cotton yarn, hosiery, paper, glass, glue, leather, beer, hammered iron, steel, iron wire, files, scythes, and other agricultural implements. A good deal of kirschwasser and extract of wormwood is made. The commerce, a large proportion of which is carried on with Switzerland, consists in the articles named, and in hides, cattle, timber, deals, oak staves, tin and iron ware, &c. The department is crossed by good roads. It is also traversed by the Canal du Rhône-au-Rhin, which commences on the Saône, in the department of Côte d'Or, and falls into the Ill at Strasbourg. There is also good railway accommodation.

The department takes its name from the river Doubs, which traverses it twice throughout its entire length. This river rises at the foot of Mont Rixon, in the south-east of the department, and runs in a north-east direction for about 70 miles, partly in the Swiss canton of Neufchâtel; at this distance from its source, striking against the chain that connects the Vosges and the Jura mountains, it glances off to westwards for about 16 miles as far as St. Hippolyte, where it receives the Dessoubre on the left bank, and takes a northern direction to within 4 miles of Montbeliard; here making a rapid semicircular sweep, first to the east and then to the north-west, it finally flows south-west, passing Clerval, Baume-les-Dames, and Besançon; a few miles below this last town it enters the department of the Jura, where it receives the Loué on its left bank, and, taking a more southerly course, reaches the department of Saône-et-Loire, in which it joins the Saône on its left bank at Verdun, after a course of 267 miles and a descent of 2605 feet. In its upper course the Doubs flows between pine-clad mountains over a limestone bed, in the cavities of which the clear rapid stream sometimes disappears altogether. On approaching the Swiss frontier in the lower part of the canton of Marteau, the river, increased by numerous streams, forms a fine broad sheet of water, pent in at its northern extremity by the mutual approach of the wild rocky precipices on each side, which leave a passage only 27 feet in width; through this gorge the river dashes perpendicularly down a space of 87 feet, and forms a most magnificent cataract, the snowy foam and thundering roar of which strikingly contrast with the gloom and silence of the frowning rocks and dark forests above. This cataract, called le Saut-du-Doubs, or "the Doubs' Leap," is the finest in this part of France. A great deal of timber is floated down the river. The navigable reaches of its south-western course form part of the Canal du Rhône-au-Rhin, which, leaving the Saône near St. Jean-de-Losne and running along the western valley of the Doubs, joins the Rhine near Mulhausen. The only other river worth notice is the Oignon, which rising in Haute Saône and flowing due south to near Villersexel, turns south-west, separating the department of Haute Saône from those of Doubs and Jura, and enters the Saône just within the department of Côte d'Or, after a course of 68 miles.

The department is divided into the arrondissements of Besançon, Baume-les-Dames, Montbeliard, and Pontarlier. The chief town is Besançon.

To the department of the Doubs attaches some of the most painful memories of the war of 1870–71. It was on a line from Héricourt, just over the border of the Doubs, to Montbeliard, that the memorable three days' battle took place on the 15th, 16th, and 17th January, 1871, on which occasion Bourbaki, with 130,000 men against Von Werder's 35,000, failed to move the German position. On the third day the French commenced a retreat to Besançon, which they reached on the 21st, in time to hear that General Manteuffel, with a large force, was pressing on by forced marches to intercept the further retreat. Finding himself thus hemmed in on nearly every side, the unhappy Bourbaki yielded to despair, attempted suicide, and the disorganized army rushed forth from Besançon almost without a commander. An attempt was made to get along the frontier to Lons-le-Saulnier, but a vigilant and powerful enemy was found barring every avenue of escape. Finally, after wandering about for days in the depth of a bitter winter, without food and with scarcely any shoes, and after enduring terrible sufferings, the 84,000 who were left of the army were driven across the frontier at Pontarlier, and laid down their arms to the Swiss on 1st February.

DOUCHE (Fr.), the name given to a jet of water propelled against some part of the body through a nozzle or pipe. The use of the douche forms an important part of the hydropathic treatment of disease, both warm and cold water being employed in this way, either separately or in alternation. By means of the cold douche water may be applied locally to a limb or joint, as in cases of old sprains,

in chronic rheumatism, or in gouty thickening of joints. It may also be used with advantage in some cases of lumbago, neuralgia, and even in paralysis, while it forms a valuable adjunct to the treatment of chlorotic and hysterical conditions. A douche of cold water poured from a height upon the face of the patient will often cut short a fit of hysterical convulsions when milder measures have failed, and this in cases where the excitement has been quite involuntary. The effect of a douche of cold water is the production, in the first instance, of a shock to the system, which is followed, first, by a deadening of the sensibility of the part to which it is applied, and afterwards by a re-action of a stimulating character.

DOUG'LAS, the name of one of the oldest and most illustrious families of Scotland. Its origin is unknown, though there is more than one tradition concerning its founder. According to one of these, the name was derived from the answer given to a Scottish king, who, having been greatly assisted in a battle by the valour of an unknown chieftain, inquired after the victory as to where the champion was, and received the answer in Erse *Sholto du glas* (behold that dark-gray man). A valley in Clydesdale was assigned him as a reward, which was henceforth known as the Valley of Douglas, and gave a surname to his descendants. Another account is that the founder of the family came from Flanders about the year 1147, and received from the Abbot of Kelso a grant of a tract of land on the Water of Douglas in Lanarkshire. He was termed Theobald the Fleming, but it is said his descendants took their surname from two Pictish words, *Dhu glas*, signifying the dark-blue stream. Both theories have had their advocates, but neither of them rests upon any sure foundation.

The first to gain a place in history was WILLIAM OF DOUGLAS, a kinsman of the powerful house of Murray, and who lived during the latter part of the twelfth and the beginning of the thirteenth centuries. He was succeeded by his son Archibald or Erkenbald, who obtained the rank of knighthood, and from whom the estates passed in succession to Sir William of Douglas, Hugh of Douglas, and from thence to Sir William of Douglas, the fifth chief of the house, surnamed the Hardy, who was deprived of his estates by Edward I. for supporting the national cause, and sent a prisoner to England, where he died about 1302.

SIR JAMES DOUGLAS, known in history as the Good Sir James of Douglas, and also as the Black Douglas, from his complexion, was the most illustrious man of the family, and one of the most remarkable of the band of heroes who vindicated the independence of Scotland against the English usurper. On the imprisonment of his father he retired to France, where he spent three years. He was then received into the household of Lamberton, bishop of St. Andrews, and was residing there when Robert Bruce, whose cause he zealously espoused, took up arms against the enemies of his country in 1305–6.

He is said to have fought in seventy battles, and to have been victorious in fifty-seven. He three times captured Douglas Castle from the English, by surprise or stratagem. and on each occasion destroyed the fortifications, "loving better," he said, "to hear the lark sing than the mouse squeak." In 1312–13 he captured the important fortress of Roxburgh. He commanded the left wing of the Scottish army at the memorable battle of Bannockburn, 1314. In 1317 he defeated an English army under the Earl of Arundel in Jedburgh Forest, and in subsequent years he made repeated inroads into England, the last and most successful of which was in 1327. The results of this expedition contributed not a little to bring about the treaty of peace between the two countries which closed the war of independence. After the death of Bruce he set out for the Holy Land bearing the heart of that monarch inclosed in a silver case for burial, but turned aside on his voyage to assist Alphonso, king of Leon and Castile, in his war with the Moorish king of Granada. In a battle fought near Theba, on the frontiers of Andalusia, he was surrounded by overwhelming numbers and slain, 25th August, 1330. The body of the hero of seventy battles was found next day on the field beside the silver casket which contained the heart of his sovereign.

SIR ARCHIBALD DOUGLAS, brother of the preceding, was lord of Galloway, and was chosen regent in 1333. He was surnamed Tyneman, in consequence of his defeats and the ill-success which attended his measures. He undertook an expedition into England, for the purpose of raising the siege of Berwick, then hard pressed by Edward III., and was mortally wounded at the fatal battle of Halidon Hill, 20th July, 1333.

WILLIAM DOUGLAS, the knight of Liddesdale, has been supposed by Tytler and other Scottish historians to have been a natural son of the Good Sir James; but this is a mistake. He was the lawful son of Sir James Douglas of Loudon, and became possessor of the lands of Liddesdale through his marriage with Margaret, daughter of Sir John Graham of Abercorn. He took a distinguished part in the expulsion of Baliol and his English partisans from Scotland. In 1333 he was defeated and taken prisoner near Lochmaben, and was kept in close confinement in England for two years. On regaining his liberty he joined the small band of patriots who were struggling against great odds to maintain the independence of their native country, defeated the English in several encounters, wrested from them Teviotdale and the other border districts, and by a dexterous stratagem recovered the Castle of Edinburgh.

He tarnished his fame, however, by his cruel murder of his friend Sir Alexander Ramsay, through jealousy of some appointments conferred on him by the king. Three years after this Douglas was taken prisoner at the battle of Neville's Cross, and was induced to purchase his liberty by entering into a secret treaty with the English king, Edward III. But his treason was discovered by his kinsman Lord William Douglas, by whom he was waylaid and killed as he was hunting in Ettrick Forest in 1354.

SIR WILLIAM DOUGLAS, a famous warrior in the reign of Robert II., was the natural son of Sir Archibald Douglas of Galloway. Douglas performed a number of brilliant exploits against the English both in Scotland and Ireland. He joined the Teutonic knights in their crusade against the pagans in Prussia and Lithuania, and was appointed admiral of the fleet. He was murdered at Dantzic about 1390 by a band of assassins hired by a certain Lord Clifford, who had fastened a quarrel on him.

JAMES DOUGLAS, second earl, was the grandson of Sir Archibald noticed above. He was a distinguished warrior, and according to Froissart closed his brilliant career in 1388 at the battle of Otterburn, a hamlet situated in Redesdale, about 30 miles from Newcastle.

ARCHIBALD DOUGLAS, third earl, called the Grim, from his complexion and aspect, lived in the feeble reign of Robert III., and was the most powerful subject in the kingdom. His daughter Margery married David, duke of Rothesay, eldest son of the king. He died in 1400.

ARCHIBALD DOUGLAS, fourth earl, obtained a victory at Linton, in East Lothian, over Hotspur and the Earl of March, in 1401; but in the following year he was defeated and taken prisoner by Percy at Homildon Hill, near Wooler, where he showed great courage, but was guilty of many grave errors as a general. He was gained over by his captor and his father, the Earl of Northumberland, to support them in a conspiracy against Henry IV. of England. Shakspeare has referred to his fierce courage at the battle of Shrewsbury. But in the end Hotspur was killed and the insurgents routed, Douglas being once more wounded and taken prisoner. He recovered his liberty on payment of a

ransom, and in 1421 joined the Scottish auxiliaries who went to the assistance of Charles VII. of France. He performed some brilliant exploits, and was rewarded for his services with the duchy of Touraine. He fell at the battle of Verneuil, 17th August, 1424, along with the greater part of the Scottish auxiliaries, that force being almost annihilated.

WILLIAM DOUGLAS, sixth earl and third duke of Touraine, inherited the family titles and estates in 1439, when it had risen to a height of power which rivalled that of the crown itself. Their estates in Galloway, Annandale, Douglasdale, and other districts of Scotland, together with the duchy of Touraine and the county of Longueville in France, yielded them revenues probably not inferior to those of the Scottish king, and they could bring into the field an army scarcely less numerous. Having by his imperious conduct excited the jealousy of Chancellor Crichton and Livingston, the royal governor, they resolved to destroy him, and having inveigled him into the Castle of Edinburgh, subjected him to a mock trial for treason, and he was beheaded, along with his brother, 24th November, 1440.

WILLIAM DOUGLAS, eighth earl, was one of the most powerful and tyrannical members of this imperious family. He was appointed lieutenant-general of the kingdom, and strove by every available means to curtail and humble the royal power, but his treasonable schemes were discovered and thwarted by Bishop Kennedy of St. Andrews. He attempted to assassinate Crichton, the chancellor, hanged Sir John Herries in contempt of the order of James II. requiring his release, and in many ways set at defiance alike the laws and the royal authority. In a quarrel arising out of his lawless conduct James II. stabbed him with his dagger in the Castle of Stirling, 13th February, 1452, and the murder was completed by the attendant nobles.

JAMES DOUGLAS, ninth earl, brother of the preceding, took up arms to avenge his death. A peace was patched up between the king and his too powerful subject, but it was not of long duration. The earl entered into negotiations with the Yorkist party in England, and receiving promises of support from them took the field at the head of a formidable army. By the sagacious policy of Bishop Kennedy, however, Lord Hamilton and other powerful barons were detached from the Douglas cause, and the earl, deserted by his friends, retired into England. His three brothers were defeated at Arkinholme by the Earl of Angus; one was killed, and another taken prisoner and executed. The vast estates of the family were forfeited to the crown in June, 1455. The following year the earl made an inroad into Berwickshire at the head of a considerable force, but was defeated by the Earl of Angus, and thereafter remained an exile in England for nearly thirty years. In 1514 he made a last attempt to regain his lost power, but was defeated at Lochmaben (22nd July) by a body of border barons, and taken prisoner. The king, James III., merely commanded him to be confined in the monastery of Lindores, in Fife, where he died four years later, and with him expired the principal branch of his great house. The earldom had existed for ninety-eight years, giving an average of only eleven years to each possessor of the title.

A great part of their estates and influence fell to—

GEORGE DOUGLAS, earl of Angus, the head of a younger branch of the Douglas family, descended from William, first earl of Douglas, by his third wife, Margaret, countess of Angus. The prominent part taken by the Earl of Angus in the overthrow of the elder branch of his family gave rise to a popular saying, that "the Red Douglas had put down the Black." The earl, who had a high military reputation, held the office of lieutenant-general of the kingdom after the death of James II. He died in 1462. His son,

ARCHIBALD DOUGLAS, fifth earl of Angus, surnamed Bell-the-Cat, became the most powerful nobleman in Scotland, and was commonly called the Great Earl of Angus. He took a prominent part in the various rebellions of the turbulent nobles against James III. He was their ringleader in the seizure of the king and the murder of Cochrane and other royal favourites at Lauder. It was his reply to the well-known fable of the mice and the cat, told by Lord Gray at the consultation of the conspirators, that procured for Angus his familiar cognomen of Bell-the-Cat, and he was one of the leaders of the rebel army at the battle of Sauchie, in which James III. was killed. When James IV. had arrived at years of discretion he gradually withdrew his confidence from the faction which had placed him on the throne, and after some disagreements the turbulent baron was compelled to act the part of a peaceful subject. He attempted to dissuade the king from his fatal invasion of England, and earnestly remonstrated against his resolution to await the attack of the English at Flodden. James was so enraged at the remonstrance that he replied, "Angus, if you are afraid you may go home." The earl is said to have burst into tears at the insult, and quitted the camp that night, but his two sons, who remained, fell in the battle. The aged earl retired into the Abbey of St. Mains, in Galloway, and died about a year after the battle of Flodden, 1514.

ARCHIBALD DOUGLAS, sixth earl of Angus, grandson of Bell-the-Cat, was possessed of great personal attractions and showy accomplishments; but these were marred by the characteristic vices of his family, lawless ambition and lust of power. He married with indecent haste, in 1514, Margaret the widow of James IV.; but disappointed in obtaining the regency, which he expected as the result of this alliance, he soon showed himself a careless and unfaithful husband, and Margaret, who was as capricious and high-spirited as he, obtained a divorce in 1525. Angus was in 1527 appointed lord chancellor of Scotland, and raised the power of his house to such a height as to threaten both the independence of the crown and the liberties of the people. But the young king, James V., succeeded in escaping out of the hands of the Douglases, stripped Angus of the authority which he had abused, and compelled him to take refuge in England, where he remained until the death of James. During the minority of Mary he was not less turbulent than before, but though at first friendly to the designs of Henry VIII., he was so enraged at the way in which his own estates were ravaged by the English that he took the field against them, and defeated them at the battle of Ancrum Moor, 1544. Margaret Douglas, his daughter by the queen dowager, was the mother of Lord Darnley, afterwards husband of Queen Mary.

WILLIAM DOUGLAS, eleventh earl of Angus, was raised by Charles I. in 1633 to the rank of Marquis of Douglas. He was a Roman Catholic, and having espoused the royal cause in the great Civil War attempted to hold out his castle against the Covenanters in 1639, but they obtained possession of it by a sudden attack. He was nominated lieutenant of the borders by Charles I., and joined Montrose after his victory at Kilsyth in 1645. He was present at the battle of Philiphaugh, where Montrose was totally defeated by General Lesley, and escaped from the field, but soon after made his peace with the dominant party. He was the father of three peers, who bore different titles—Archibald, his eldest son, who was the second marquis; William, who married the heiress of the great family of Hamilton, and became first Duke of Hamilton; and George, who was created Earl of Dumbarton.

ARCHIBALD DOUGLAS, third marquis, succeeded to the title and estates in 1700, and was created Duke of Douglas in 1703. In the rebellion of 1715 his grace adhered to the royal side, and served as a volunteer in the battle of Sheriffmuir. On his death in 1761, without issue, the ducal title became extinct. The marquisate, which descended through heirs male, went to the direct representative of this famous old house, the Duke of Hamilton, but

the extensive estates of the family were inherited by Archibald Stewart, son of Sir John Stewart of Grandtully and of Lady Jane Douglas, only sister of the Duke of Douglas. He was created a British peer in 1790, by the title of Lord Douglas of Castle Douglas, but the title became extinct in 1858, on the death of James, fourth baron.

DOUG'LAS, GAWAIN, was a descendant of the house of Douglas, which from the twelfth century till the present time has produced many individuals of considerable eminence, but chiefly warriors or statesmen. The exception is Gawain the poet. He was born in 1475, and was the third son of Archibald, fifth earl of Angus, surnamed Bell-the-Cat. He was carefully educated for the church, and eventually became first abbot of Aberbrothock and then bishop of Dunkeld; but his elevation to the archbishopric of St. Andrews was prevented by the pope. In 1518 some political intrigues compelled him to retire to England, where he was favourably received by Henry VIII. He died of the plague in 1522 at the Savoy, London. He is best and most deservedly known by his metrical translation of Virgil's Æneid, which was produced in 1513. Each book is prefaced by an original prologue by Douglas, and it is especially these prologues which have earned him a place in our literature. Like all the old Scottish poets he was permeated with a love for nature, and draws mainly upon his sympathetic observation of natural scenes for his important effects.

DOUG'LAS, a seaport, market-town, and watering place of the Isle of Man, situated on the eastern side of the island, on the shores of a lovely bay extending between 2 and 3 miles across. The old part of the town is very irregular, but so popular has the town become as a watering place, and so rapidly is it progressing in population and importance, that new streets, houses, and terraces are extending in all directions. A handsome hall has been erected for the meetings of the House of Keys and the other branch of the legislature. There are some very fine hotels in the town, notably the Imperial and the Castle Mona, formerly the residence of the Duke of Athole. Queen Victoria Pier, 1100 feet in length, and 50 feet wide at the top, was opened in 1872. An outer pier, which serves also as a breakwater, was completed in 1879. The structure is of a massive character, and well adapted to resist the heavy seas to which it is exposed. The depth at the inner berthage is 18 feet at low water, and 39 feet at high water. There is regular steam communication with Liverpool, Fleetwood, and Barrow. The population of Douglas in 1881 was 15,719. Sir William Hillary resided here in 1832, and founded the Royal National Lifeboat Institution. The town derives its name from the fact that the rivers Dhoo and Glass, uniting their waters a short distance above the town, flow past it as one river, the Dhooglass.

DOU'RO or **DUERO,** a river of Spain and Portugal, rises in the north part of the province of Soria, in Old Castile. It flows first south, passing the town of Soria, then west through the provinces of Burgos, Valladolid, and Zamora, receiving numerous affluents, the principal of which are the Pisuerga, Seguillo, and Esla, noticed in the articles bearing the names of the provinces through which they flow. After receiving the Esla, the Douro reaches the frontiers of Portugal, where it turns south, and for about 50 miles separates the province of Salamanca, in Spain, from that of Tras-os-Montes, in Portugal. In this part of its course it receives the Tormes and the Agueda. The Douro then, turning again west and crossing the north of Portugal, divides the provinces of Tras-os-Montes and Entre-Douro-e-Minho from that of Beira, and enters the Atlantic 2 miles below the city of Oporto, of which it forms the harbour. The whole course of the Douro with its windings is about 400 miles, through some of the finest and most fertile regions of Spain and Portugal. The bar at the mouth of this river prevents large vessels from entering it; ships of 16 feet draught can scarcely get in even at high water. For river craft the Douro is navigable above 100 miles inland, and affords a ready outlet for the wines, oil, wool, cork, fruit, &c., of the rich provinces which it drains.

DOVE, a general name for the family of birds Columbidæ, synonymous with PIGEON.

DOVE (River). See DERBY.

DOVEDALE OF THE PEAK is one of the most picturesque and striking localities in the kingdom. It is so called from being in the Peak of Derbyshire and from the name of the river Dove, which flows through the valley. It is approached through a defile of high and precipitous limestone rocks so narrow that in the depth of the winter months the inhabitants never see the sun. The precipitous rocks on each side of the valley are 3 miles in extent, the sides in some cases closely approximating. Sometimes their opposite sides present salient and re-entering points which so exactly correspond that it seems as if the valley had been formed at once by some convulsion of nature which had rent asunder what had originally formed a compact mass of rock.

DO'VER, a municipal and parliamentary borough of England, and one of the Cinque Ports, in the county of Kent, 88 miles from London, being the terminus of the London, Chatham, and Dover Railway, and 15 miles S.E. of Canterbury, is situated on the coast, in a narrow valley between two high ranges of chalk hills, which are broken through and form lofty precipices in front of the sea on each side of the town, and on the south side rise perpendicularly above the houses and close behind them. On the east side, about a mile distant, is Shakspeare Cliff, so called from the celebrated scene in "King Lear," 400 feet high, and on the west side near the town is Dover Castle, with its irregular lines of fortifications on the brow of the cliff, and its numerous galleries excavated far below in the chalk rock. The Castle Cliff is 325 feet above the sea, but the heights are much loftier. The castle is a collection of formidable works occupying 35 acres, containing Roman and Saxon towers, a Roman-British church, one of the most curious relics in Christendom; a keep forming a bomb-proof magazine, and barracks for 2000 men. The town extends some distance up the valley, and stretches out on each side as far round as the cliffs will allow. Works have been commenced for carrying a tunnel under the Channel, but the disadvantages of such a connection with the Continent are so obvious, and the advantages likely to be derived are so small, that the government are not likely to allow the scheme to be carried out. The Dour, a small but clear stream, flows through the valley and falls into the harbour. The town has been much improved, an efficient drainage and water supply have been carried out, and it is now the resort of many fashionable visitors. Several fine hotels have been built, the Lord Warden being constructed by the South-eastern Railway Company; the Imperial, opened in 1867, is a large structure facing the sea, with tall campanile tower, and contains 230 rooms. There are on the north side handsome crescents, parades, and terraces. It is the chief packet-station for the opposite ports of France, and the prosperity of the place depends in a great measure on the intercourse between England and the Continent. The imports consist mainly of eggs, fruit, and other rural produce from France, and there is also a thriving coasting trade and fishery. The number of vessels registered as belonging to the port in 1884 was 60 (4000 tons). The entries and clearances average 2900 (640,000 tons) per annum. The customs duties received at the port annually, average about £28,000. The harbour consists of three basins, the outer one inclosed between two piers 150 feet apart. The Admiralty Pier was commenced in 1847 and completed in 1875. It incloses 574 acres as a harbour of refuge. It is

constructed of concrete formed of shingle, sand, and Portland cement, with a facing of large blocks of granite, and is 84 feet wide at the base and 45 feet at the quay level. At the pier-head is a fort of enormous strength, intended to defend the entrance to the harbour. It has a revolving turret, on which is mounted a gun of the largest size. The port is 21 miles from Cape Grisnez, on the opposite side of the English Channel, and 26½ north-west of Calais. Fortifications of immense strength have also been erected on the heights commanding the town. Shipbuilding, sail, rope, and paper making are the chief branches of industry which occupy the population. The town is well provided with schools and places of worship of all kinds, and has numerous benevolent institutions. Dover is the seat of quarter-sessions, has a board for licensing pilots, and a court of the Constable of the Cinque Ports is held here. The municipal borough is divided into three wards, and is governed by six aldermen and eighteen councillors. It returns one member to Parliament.

The population of the parliamentary borough in 1881 was 30,270, as against 28,506 in 1871.

On account of its position as the nearest landing-place from the Continent, Dover has from the earliest period been a place of some importance. It was the place at which Julius Cæsar intended to land his forces when he invaded England, but the heights appeared to him so formidably defended by the Britons that he was obliged to go further north. It was called *Dwyr* (from *Dwyffyrrha*, a steep place) by the ancient Britons, *Dubris* by the Romans, *Dofre* or *Dovre* by the Saxons, and in Domesday Book appears under the name of *Dovere*. As the principal of the Cinque Ports it figures conspicuously in history.

DO'VER, a handsome and flourishing town of the United States, the capital of the state of Delaware, on Jones' Creek, and on the Delaware Railway, 50 miles south of Wilmington and about 5 west of Delaware Bay. It has a fine state-house, with an open lawn in front, several churches and seminaries, large hotels, and many elegant residences. The houses are mostly built of brick, and the streets are wide and spacious. Dover has increased rapidly for some years past. Population, 7839.

DO'VER, STRAIT OF, separating England from France, is 21 miles across from the South Foreland, S.S.E., to Cape Grisnez. The bottom of the strait forms an elevated ridge, on both sides of which the water deepens gradually towards the German Ocean and the English Channel. The shallowest part follows a line drawn between Dungeness, in Romney Marsh, and Boulogne, and is in many parts no more than 2 fathoms deep; general depth, 18 to 30 fathoms. This form of bottom, the perfect correspondence of the geological formations on opposite sides, the existence of a remnant of land in the Goodwin Sands, which are not a mere tidal bank; the identity in the fauna, and the existence in England of the remains of large quadrupeds—the elephant, rhinoceros, &c.—coupled with indications at the bottom of the cliffs of oscillations in the relative level of sea and land during the modern period, render it certain that the two countries were formerly connected.

DOVER'S POWDER, known in the Pharmacopœia as compound ipecacuanha powder, is made by thoroughly mixing one part of ipecacuanha and one part of opium with eight parts of sulphate of potassa. Ten grains is a full dose. A powerful diaphoretic, producing copious perspiration, it may be used with advantage in the early stage of a common cold, but it does not agree with everybody, and care must always be taken after its use to avoid a fresh chill.

DOVETAIL is the end of a piece of wood fashioned into the fan-like form of a dove's-tail, and let into a corresponding hollow of another piece of wood.

DOVRE FIELD. See NORWAY.

DOW'AGER is a widow who is endowed [see DOWER]; but the title is often applied to ladies of rank, whether they may be endowed or not. A queen-dowager is the widow of a king.

The last queen-dowager (Adelaide) had by Act of Parliament (1 & 2 Will. IV. c. 11) a pension of £100,000, and also Marlborough House, London, and the rangership of Bushey Park, in Middlesex, for life.

DOWER is that part of the husband's lands, tenements, or hereditaments to which the wife is entitled for her life upon the husband's death.

The law of dower was regulated by 3 & 4 Will. IV. c. 105, which abolished certain kinds of dower. The objects of this Act were—1, to make equitable estates in possession liable to dower; 2, to take away the right to dower out of lands disposed of by the husband absolutely in his life or by will; and 3, to enable the husband, by a simple declaration in a deed or will, to bar the right to dower. By this Act it is provided that no woman shall be entitled to dower out of any lands absolutely disposed of by her husband either in his life or by will, and that his debts and engagements shall be valid and effectual as against the right of the widow to dower. And further, any declaration by the husband, either by deed or will, that the dower of his wife shall be subjected to any restrictions, or that she shall not have any dower, shall be effectual. It is also provided that a simple devise of real estate to the wife by the husband shall, unless a contrary intention be expressed, operate in bar of her dower. For the corresponding rights in Scotland see TERCE.

DOW'LAND, JOHN, one of the sweetest of the Elizabethan musicians, is known to us not only by some exquisitely beautiful madrigals and airs which are universal favourites, but also as a fine lute player by the famous sonnet of Shakspeare, whose friend he was. Addressing a mutual friend, Shakspeare says—

"If music and sweet poetry agree,
As they must needs, the sister and the brother,
Then must the love be great 'twixt thee and me,
Because thou lov'st the one and I the other.
Dowland to thee is dear, whose heavenly touch
Upon the lute doth ravish human sense;
Spenser to me," &c.—"*Passionate Pilgrim*," vi.

Dowland was born in Westminster in 1562, and became Mus. Bac. at Oxford in 1588, afterwards at Cambridge also. He took part in composing the harmonies to Este's "Psalmody." In 1597 he published his first book of "Ayres" in four parts, with lute accompaniment (reprinted with pianoforte accompaniment in 1844). This ran through many editions, and procured him an invitation from the King of Denmark. While in the Danish service he published his second and third books of "Ayres," this time in two, four, or five parts, and with accompaniments for the lute and viol da gamba, in 1600 and 1602 respectively. In 1609 he returned to England, and was lutenist to King James I. He died in 1626. Other works of Dowland's are his "Lachrymæ, or Seven Tears, figured in Seven Passionate Pavans" (a pavan being an ancient dance form), 1605, and a "Pilgrime's Solace," in three, four, and five parts, to be "sung and plaid with lute and viols."

DOWN, a county of Ireland, in the province of Ulster, is bounded N. by Antrim and Belfast Lough, E. and S. by the Irish Channel and Carlingford Bay, and W. by Armagh. The greatest length, north-east and south-west, is 51 miles. The greatest breadth, north-west and south-east, is 38 miles. The area is 967 square miles, or 612,495 acres. The population in 1881 was 272,107.

Down forms the south-eastern extremity of Ulster. The surface of nearly all the county is undulating, but the only uncultivated district is that occupied by the Mourne Mountains and the detached group of Slieve Croob. The highest mountain in the county is Slieve Donard, 2796 feet.

There are about a dozen other mountains exceeding 1000 feet in height. • With the exception of the two mountain groups the numerous hills which diversify the surface are seldom too high for arable cultivation, and the irregularity of the surface facilitates drainage, and likewise affords a shelter which, from the scarcity of timber in some parts of the county, is of material advantage.

Beginning the coast line at Belfast Lough there is a small quay for fishing and pleasure boats at Cultra; then a small harbour and pier at Bangor; next a little harbour at Groomsport; and next beyond this the town and harbour of Donaghadee, in front of which lie three islands called the Copelands, on one of which is a lighthouse. South from Donaghadee the coast is low, rocky, and dangerous; there are small fishing stations at Ballywater, Ballyhalbert, Cloghy, and Portaferry, and a lighthouse on Kilwarlin rock. Near Portaferry is the deep inlet of Strangford Lough. The lough is connected with the sea by a very narrow channel 5 miles long by about one in breadth, across which is a ferry. It contains many islands and several good anchorages and landing quays. After passing the small harbour of Ardglass we arrive at the large Bay of Dundrum, which extends about 10 miles across and 3 or 4 in depth. This bay is exposed, shallow, and full of quicksands, which have occasioned vast loss to shipping. The *Great Britain* steam-ship was stranded here from September, 1846, to August, 1847. A few small boat-harbours intervene between Dundrum Bay and Carlingford Bay, which is an extensive inlet running 8 miles inland to Newry, and bounded by steep mountains on each side. There are anchorages within the Bay at Carlingford, Rosstrevor, and Warren's Point.

With the exception of the Upper Bann all the rivers of Down discharge their waters into the Irish Channel. The chief of them are the Lagan, the Ballynahinch or Annacloy River, which widens into the Quoile, and the Newry River. The Lagan navigation is an artificial water-communication from Lough Neagh to Belfast Lough. The Newry Canal establishes a water communication between Lough Neagh and Carlingford Bay. Down is well supplied with roads and railways.

The vicinity of the sea prevents the continuance of frosts on the east and south, and the insulated position of the mountainous tract confines the heavier mists and rains to that part of the county where their effects are least felt. The general inequality of the ground carries off surface waters and prevents damps, so that the climate, although somewhat cold, is considered very wholesome. The prevailing winds in spring are from the east.

The chief geological features are strongly marked. The Mourne and Slieve Croob groups consist of granite. Northward and eastward of the granite district the whole of the remainder of the county is occupied by an extension of the transition series which forms the southern basin of Lough Neagh. Clay slate in greater or less degrees of induration is the prevalent rock. Towards the sea on the north-east and east slate quarries are common. Near Moira is a little of the Tertiary limestone, and isolated portions of limestone occur in other spots. Copper, lead, coal, and chalybeate springs are found at various places in the county.

The prevalent soil in the low district is a stony loam. Clayey soils are confined to the north-east of the county and the barony of Ards, and are of a strong and productive quality, but they are wet and require a large quantity of manure. The richest soil in the county is in the district of Lecale. Alluvial tracts are frequent and yield luxuriant crops of grass without manure. Moory land is confined to the mountain district. Agriculture is well conducted, and the farm buildings and cottages are very superior to those in more southern counties. More than half the entire area is under cultivation. Large numbers of live stock are reared and fattened in the county, and of late years much attention has been given to the improvement of the breeds.

The linen manufacture is the staple trade of Down, and gives employment to a greater number of operatives, in proportion to the population, than any other part of Ireland. Much of the flax used is grown in the county, seed for it being imported from Flanders. There are about a dozen towns in which linen markets are held. The bleaching of the woven linen is a large branch of industry conducted in bleachfields on the banks of the river Bann. The remaining articles of manufacture in the county are jute, leather, hosiery, and salt. There are also some breweries, distilleries, corn-mills, and soap-works. The fisheries on the coast are rather extensive, but are not pursued with anything like the vigour and success they might be. The chief exports of the county are shipped at Belfast and Newry.

Divisions, Towns, &c.—The county of Down is divided into fourteen baronies, which include about seventy parishes. It is the only Irish county to which the affix *shire* may be added. It returns four members to Parliament, and one member for the borough of Newry. The number of parliamentary voters on the county register in 1884 was 12,700. Downpatrick is the capital of the county.

History and Antiquities.—Before and for some time after the invasion of the English, Down was known as Ulladh or Ulidia, the original of the name of Ulster. The ancient inhabitants are supposed to have been the Voluntii of Ptolemy. The north-eastern portion of Down was at an early period occupied by the Picts. This region abounds with stone circles, cromlechs, and subterranean galleries, which usually mark the presence of this peculiar people.

The presence of St. Patrick in this county in the sixth century is attested by authentic records, and can be traced with topographical exactness at the present day. Downpatrick, Saul, Dromore, Moville, and Bangor were the chief ecclesiastical foundations of the saint and his immediate successors. Newry Abbey was established in 1153. The county was overrun by the English in 1177. In 1333 the Irish overturned the English rule in Ulster, expelled many of the Anglo-Norman families, and remained supreme in the county for more than two centuries. During the sixteenth and seventeenth centuries, by deaths, conquests, and confiscations, the English crown gradually acquired power over the whole county.

Of the pagan antiquities of Down the most remarkable is a stone cromlech, inclosed by a circular ditch of extraordinary dimensions, called the Giant's Ring, near Lisburn. The inclosure is nearly half an English mile in circumference, and the ramparts are still from 12 to 14 feet in height. There are stone monuments of the same character at Sliddeny Ford, near Dundrum, and Legaraney in the parish of Drumgoolan. There is a remarkable cairn, or sepulchral pile of stones, on the top of Slieve Croob. Along the Armagh boundary of Down there extends a great earthen rampart, called by the people of the county the Dane's Cast, and sometimes Tyrone's Ditches. There are numerous raths or earthen entrenched mounds throughout Down, of which the most remarkable are at Downpatrick, Donaghadee, and Dromore. Of the Anglo-Norman military antiquities of Down the Castle of Dundrum is the most important. It is imposingly situated on a rock over the bay, and consists of a circular keep with numerous outworks, which underwent many sieges between the fourteenth and seventeenth centuries. There are other military and castellated remains at Mourne, Newcastle, Castlewellan, Rathfriland, Ardglass, Killough, Ardquin, Portaferry, Bangor, and Hillsborough.

The chief ecclesiastical remains in Down are at Downpatrick, where there are the ruins of the cathedral and of three other religious houses. There is a round tower at

Drumbo, near Belfast. At Greyabbey there is still standing in good preservation a part of the ancient abbey founded here in 1192 by Africa, daughter of the King of Man and wife of De Courcy. Near Downpatrick, at the base of Slieve-na-Griddle, are the wells of Struel, or, as they are sometimes called, St. Patrick's Wells.

DOWN is the term applied to the soft feathers which immediately cover the skin of birds. That obtained from some kinds of water-fowl is applied to many useful purposes, eider and swan's down being the most valuable. The quantity of down annually imported into the United Kingdom averages from 40,000 to 50,000 lbs., the price being about 3*s.* per lb. The term is also applied, in botany, to the fine hair of plants, and is a cellular expansion of the cuticle, consisting of attenuated, thin, semitransparent hairs, either simple or jointed end to end, or even branched, as in the Mullein. When attached to seeds it renders them capable of being buoyed up in the air and transported from place to place.

DOWNING COLLEGE, CAMBRIDGE, was founded by Sir George Downing, Bart., of Gamlingay Park, in Cambridgeshire, who by will dated 20th December, 1717, devised estates in the counties of Cambridge, Bedford, and Suffolk, first to Sir Jacob Gerard Downing, and afterwards to other relations in succession, and in failure thereof, to build and found a college in this university, on a plan to be approved of by the two archbishops of England and the masters of St. John's and Clare colleges. The college was founded by charter, 22nd September, 1800; the statutes were framed in 1805; and a piece of land having been purchased, the first stone of the college was laid 18th May, 1807; but it was not till 1821 that buildings sufficient for opening the college, and comprising nearly two sides of a large court, were completed. A new wing was added to the college in 1876.

Under the new statutes this college consists of a master, two professors (one of the laws of England and the other of medicine), at least eight fellows (two of whom only are required to reside), and ten scholars. The objects of the foundation are stated in the charter to be the study of law, physic, and other useful arts and learning. The annual value of a foundation scholarship is now £50, with the addition, in some cases, of rooms rent free, and an allowance for commons. They are tenable at least until the holder be of standing to take a degree in arts, law, or medicine, with a power of further extension vested in the society. Minor scholars may also from time to time be elected from persons who are not members of the university, or who have not resided one whole term in any college in the university. Provision is made for one or two chaplains, according to the circumstances of the college, the right of appointment being vested in the master. The professors are elected by the archbishops of Canterbury and York and the masters of St. John's, Clare, and Downing colleges.

DOWNPAT'RICK, the assize town of the county of Down, in Ireland, and formerly a parliamentary borough, is situated near the south-western angle of Strangford Lough, 18 miles S.E. of Belfast. It consists chiefly of four main streets, which meet near its centre. Its chief buildings and institutions are a cathedral, an Episcopalian church, a Roman Catholic, two Presbyterian, and a Methodist chapel, county court-house, county prison, diocesan school, union workhouse, lunatic asylum, infirmary, fever hospital, and barracks. The cathedral was defaced by Edward Bruce in 1316, and again by Deputy Gray in 1538, but it has been thoroughly restored, and the interior handsomely decorated. There are shown the tombs of St. Patrick, St. Columba, and St. Bridget. The town has manufactures of linen, soap, leather, and malt liquors. A small export trade is carried on by means of vessels of 100 tons, which can come up to Quoile Quay, a mile from the town—vessels of larger tonnage discharge at the steamboat quay, lower down the river, and there is also a railway to Donaghadee harbour. A rath not far from the gaol, and formerly known as the *Rath Keltain* (the Fort of Celtain), is the largest in the county, being 895 yards broad at the base and surrounded by three ramparts. A short distance to the east of the town are the famous wells of Struel, to which on midsummer-day crowds of pilgrims formerly resorted. The population in 1881 was 3901—1825 being male and 2076 female. The number of inhabited houses was 747.

DOW'RY among the ancients had some peculiarities calling for brief notice.

In Homeric times the husband purchased his wife, in fact, by rich gifts given to her relations; but in historic times the wife usually brought a dowry to her husband. This, however, though used by him, was always considered to belong to the wife and children, and was returned to the wife in case of a divorce.

The great facility and frequency of divorce among the Romans (so that St. Jerome speaks of a twenty-fifth wife marrying a twenty-fourth husband) led to much complexity in arrangements of dowry; for though the husband retained the dowry as his property, an endowed wife (*uxor dotata*) had great power over him, as if divorced she could claim her dowry, and this would probably put him to inconvenience. The comic dramatists and the satirists have made much merriment over this situation.

DOXOL'OGY, the name of a form of giving glory to God, is applied to the concluding paragraph of the Lord's Prayer, "Thine is the kingdom, and the power, and the glory," which is left out of many of the ancient copies of St. Matthew's Gospel, and entirely in that of St. Luke. The *Gloria Patri*, or "Little Doxology," introduced by the Athanasians to enforce their dissent from the Arian faith, is the short hymn used in the church service at the end of each psalm, and of which there is a rhythmical version in several metres. The "Great Doxology," the *Gloria in Excelsis*, is simply an expansion of the angelic hymn (Luke ii. 14) sung in the Roman Catholic mass.

DRA'BA is a genus of plants belonging to the order CRUCIFERÆ. *Draba verna* (common whitlow-grass) is an exceedingly common plant, ornamenting old walls and dry banks in the spring, before other flowers make their appearance. It is found throughout Europe, and is most abundant in Great Britain. *Draba aizoon* (evergreen whitlow-grass) is a native of Bavaria, Austria, Hungary, Transylvania, and the Carpathian Mountains. *Draba aizoides* is a native of gravelly soils in almost every country of Europe. It is a rare plant in Great Britain, and has been found on rocks and walls at Pennard Castle, near Swansea. This plant is suitable for rock-work, as it has bright-yellow flowers and glossy leaves with hairy margins. In this genus the pod (silicle) is short, only slightly convex, with the dissepiment in its broadest diameter, and numerous seeds.

DRACÆ'NA, a genus of plants belonging to the order Liliaceæ, and nearly allied to Yucca and Cordyline; the ovules are solitary in each cell, and erect; the berry is indehiscent. The genus was established by Linnæus, and named from one of its species yielding the resinous exudation familiarly known by the name of Dragon's Blood, a translation of the Arabic name *dum al akhwain*, met with in Avicenna and other Arabian authors.

The species of Dracæna are thirty-five in number, and found in the warm parts of the Old World and in many of both Asiatic and African islands, whence they extend southwards to the Cape of Good Hope and Australia, and northwards into China and to the eastern parts of India, as the districts of Silhet and Chittagong. Species are also found in Socotra and the Canary and Cape Verd Islands, as well as at Sierra Leone. From this distribution it is evident that the species require artificial heat for their cultivation

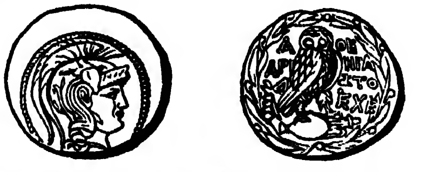
in England. They are found to thrive in a light loam, and may be grown from cuttings sunk in a bark bed.

Of the several species of Dracæna which have been described by botanists, there are few which are of much importance either for their useful or ornamental properties. Among them, however, may be mentioned *Dracæna terminalis*, a species rather extensively diffused. The root is said by Rumphius to be employed as a demulcent in cases of diarrhœa, and the plant as a signal of truth and of peace in the Eastern Archipelago. It "is tuberous, and often weighs from 10 to 14 lbs., and after being baked on heated stones much resembles in taste and degree of sweetness that of stick liquorice. The Vitians chew it, or use it to sweeten puddings. They were ignorant of the art of extracting an intoxicating liquor from it, known to the Hawaiians. The leaves are excellent fodder for goats, sheep, rabbits, and cattle, and are used for this purpose by the white settlers. In the Hawaiian Islands it is used for hedges, and the leaves for thatching and for wrapping up bundles of food, charcoal, &c.; the leaves also serve among the native women as a medium for communicating ideas, which appears to be somewhat similar to the system of quipos employed by the ancient Incas." (Seemann, "Flora Vitiensis.") In the islands of the Pacific Ocean a sweetish juice is expressed from its roots, and afterwards reduced by evaporation to sugar. The root is called *ti* or *tii* in the island of Otaheite, and thence no doubt corrupted into *tea-root* by the English and Americans. In the Sandwich Islands generally an intoxicating drink is prepared from this root, as well as from the roots of *Piper methysticum*.

Dracæna Draco is the best known species, not only from its producing dragon's blood, but also from one specimen having so frequently been described or noticed in the works of visitors to the Canary Islands. The most celebrated specimen of this tree grew near the town of Orotava, in the Island of Teneriffe, and was found by Humboldt in 1799, at several feet above the root, to be about 40 feet in circumference; lower down it measured nearly 79 feet. Sir G. Staunton had previously stated it to be 12 feet in diameter at the height of 10 feet, and Ledru gave even larger dimensions. The great size of this enormous vegetable is mentioned in many of the older authors; indeed, as early as the time of Bethencourt, or in 1402, it is described as large and as hollow as it was a few years ago; whence from the slowness of growth of Dracænas has been inferred the great antiquity of a tree which four centuries so little changed. But it is probable that this tree was not nearly so old as was supposed, for it is now known that the Dracæna is of very rapid growth when young. It was destroyed by a hurricane which occurred in 1867. See DRAGON'S BLOOD.

DRACHM or **DRAM.** There are two drachms remaining in our system of weights; the first is the sixteenth part of the ounce, which is the sixteenth part of the pound avoirdupois of 7000 grains. In the national standard, the troy pound of 5760 grains, there is no dram; but this weight occurs in that particular division of the troy pound which is used by apothecaries, in which the dram is the eighth part of the ounce, which is the twelfth part of the pound of 5760 grains.

DRACHMA (Gr. *drachmé*, literally a handful). Like the Roman As, the Greek drachma was both a weight and a coin; and, as in the case of the as, the metal which once served both to buy and to measure soon became of different values in these different capacities. We have the same case in the English *pound* and the French *livre*. As a coin the Attic drachma was in silver, and in value about equal to a French franc. The drachma was the chief coin in use among the ancient Greeks. It was divided into six oboli (*oboloi*), and there were silver half-drachmæ, and smaller coins down to quarter-oboli in the best times of Athens. Later the obolus was degraded to bronze. The didrachma, tridrachma, and the tetradrachma (two, three, and four drachmæ), sometimes called the silver STATER, were its multiples. The last was the largest form of Greek silver. The average weight of five drachmæ in the



Drachma in the British Museum—silver (actual size).

British Museum is 60·92 grains, and of three tetradrachmæ, 260·56 grains.

DRACIN'A or **DRACO'NIN**, the colouring matter of dragon's blood. It is of fine red colour and very fusible; it may be worked between the fingers, and drawn into threads. It melts at about 130° Fahr.

DRA'CO (the Dragon), one of the old constellations, referred by Hyginus to the fable of the Hesperides. It is constantly stated by the older writers as being placed between Ursa Major and Ursa Minor, which hardly suits the present position of the constellation, since its principal stars are all contained between Ursa Minor, Cepheus, Cygnus, and Hercules. The two stars in the head (β and γ, the latter celebrated as passing very near the zenith of the south of England, and as being the one used in the discovery of aberration) are nearly in the line joining α Cygni (Deneb) and Arcturus; while seven or eight smaller stars wind round Ursa Minor in such a manner as to render the name of the constellation not inappropriate. The extreme star (λ) is very nearly between the Pole-star and its pointers. But as Mr. Proctor has pointed out, if β and γ are taken as the eyes and 81 Hercules as the tip of the nose, a very fair winged dragon may be constructed, which was more probably the ancient constellation than the present nondescript animal. Draco is figured in our Plate CONSTELLATIONS, Northern Hemisphere, close to the Pole, twice crossing the solstitial colure. The star α Draconis, called Thuban by the Arabians, and much brighter once than it now is, which lies near the tail of the Great Bear, is very remarkable as having been at one time the Pole-star. Indeed it was much more accurately the Pole-star about 2700 B.C. than the present Pole-star is now; for, as probably all readers know, our Pole-star describes daily a circle round the true polar point. The place of the Pole reels round in a circle in 25,868 years, and the curve from α Draconis (Thuban) to the present Pole-star is between a fifth and a sixth of this circle. The polarity of Thuban leads to some very remarkable results as to the orientation of the Great Pyramid [see PYRAMIDS], and explains the names of many of the constellations, now so distorted, as may be proved by anyone rotating a celestial globe with a point near Thuban for its pole. He will see Argo sail on an upright keel, Centaur and Altar will stand erect, &c.

DRA'CO, an Athenian legislator who was living in 621 B.C. Suidas says that he brought forward his code of laws in this year, and that he was then an old man. This code was extremely severe, and the proverb of the ancients was that Draco's laws were written not in ink but blood; hence our own common phrase "Draconian severity." Nearly all crimes were punishable with death. Solon in 594 modified this code very considerably. But its original severity is probably exaggerated. Aristotle says ("Polit." ii., at the end) that Draco adapted his laws to the existing constitution, and that they contained nothing peculiar beyond the severity of their penalty, which, in many cases, was death. Draco is said to have been much honoured and to have perished through the cloaks of a large assembly in the theatre at Ægina being

thrown upon him or before him in compliment, as in our day we throw a bouquet to a singer.

DRACON'TIUM (from a Greek word signifying a snake, because the stem is mottled like the skin of a serpent), a genus of plants belonging to the order AROIDACEÆ. *Dracontium polyphyllum* has a tuber resembling a small cake, producing one or two leaves, with long, clouded spotted petioles, resembling the skin of a snake. It smells so powerfully on first expanding that persons have been known to faint from the stench. It is also said to excite the nerves of hearing, and even induce a state of catalepsy. It is a native of Guiana, Surinam, and other parts of equinoctial America, where it is called Labarri, and regarded as a remedy against the bite of the Labarri snake, which its spotted leaf-stalks resemble in colour. The *Dracontium fœtidum* of Linnæus, the skunk-weed and skunk-cabbage of the United States, is now referred to the genus Symplocarpus. The genus is allied to Orontium, Anthurium, Pothos, and Acorus. There are six species, all natives of tropical America. The spadix is cylindrical, with the flowers on the upper part, the whole inclosed by an overarching persistent spathe. The flowers are hermaphrodite, with from four to eight segments in the perianth. The ovary has from two to four cells, each with a single ovule, which is affixed to the inner angle.

DRAG'OMANS (from the Turkish *Trukeman*), the interpreters attached to the European consulates and embassies in the Levant, and the guides or couriers of travellers in the East, especially in Egypt and Palestine. At Constantinople they are the chief, and in most cases the sole, medium of communication between Christian ambassadors who are ignorant of the Turkish language, and the Ottoman Porte. They are men born in the country, and are chiefly descended from old Genoese or Venetian settlers.

DRAG'ON, a name frequently mentioned in the allegories of the Jews, Chinese, and other Oriental nations. Among the Greeks and Romans it was a kind of fabulous monster furnished with wings and feet, and having the head and body of a serpent. "It is from those giant serpents," says Dr. Kitto, "which at a remote period were evidently still more colossal than that which is reported to have opposed a Roman army, or the skeleton of another, above 100 feet in length, found more recently in India, that the vague but universally spread notions must have arisen in the earliest antiquity, and been perpetuated to our own time, which typified the deluge and all great destructive agents under the form of a dragon or monster serpent. We find them embodied by the ancients in the form of dragon temples, consisting of huge stones set upright in rows, such as that of Colchis no doubt was. Such temples once existed in Asia Minor. Northern Africa, Gaul, and Britain (that at Abury in Wiltshire being several miles in length); and where their design can be traced out sufficiently in existing remains the serpentine figure is ever observed to glide through or sustain a diagram of similar materials—a circumstance which appears best explained by considering them more or less astronomical, but fundamentally reposing upon traditions concerning the ark, the preserver of human life in the act of struggling with the overwhelming element." These dragons are frequently introduced into the legends of mediæval chivalry. Hercules, Apollo, and Perseus are all represented as slayers of dragons. One is represented in the Vedic mythology as the antagonist of Indra, and in the Apocalypse the angel lays "hold on the dragon, that old serpent, which is the devil." Hence it is a favourite symbol of art to represent the triumph of Christianity over unbelief by a dragon transfixed or trodden under foot, as in the case of St. George and the dragon.

DRAG'ON (Draco) is the formidable name of a genus of small arboreal lizards, distinguished by having a wing-like expansion of skin along their sides, supported by the six anterior false ribs, which are slender and extend outwards, stretching the membrane at the will of the animal. By means of this parachute these creatures are enabled to skim from branch to branch, like flying squirrels, with great ease, but they cannot beat the air as the bat does. When not in use the membrane is folded so close to the body as to be almost imperceptible. It is highly ornamented. Below the throat hangs a long pointed dewlap, supported by the hinder horns of the hyoid bone. On each side of the neck is a fold of skin, and there is generally a small cervical crest. The limbs are long; the thighs are destitute of pores; the tail is long and slender; the tongue is thick and rounded; the skin is covered with small imbricated scales, of which those of the limbs and tail are carinated. In their habits these little sweeping lizards are arboreal, and search among the leaves and in the crevices of the bark of trees for insects. They are prompt in their actions. Several species are known, natives of India, the larger Malay islands, and the Philippines. The best known species is the *Draco volans*. They are all very small animals, measuring as a rule only 2 or 3 inches exclusive of the tail. Mr. Wallace says that when their "wings" are expanded in the sunshine they look more like some strange insect than a lizard.

DRAG'ON ROOTS, a term applied to pieces of cane that have had the fibres of the wood beaten out and separated at the one end, so as to form a sort of brush. They are used for the purpose of cleansing the teeth. The decorticated roots of the vine and marsh-mallow are sometimes employed for the same purpose.

DRAG'ONET (Callionymus) is a genus of fishes of the order ACANTHOPTERYGII and the GOBY family (Gobiidæ). The dragonets are remarkable for their gills having but a single small opening placed near the nape of the neck. Their ventral fins are widely separated, larger than the pectorals, and situated under the throat. The head is oblong and depressed. The eyes are placed on the top of the head and rather close together. The body is smooth and without scales. The upper jaw is very protractile. The teeth are small, numerous, and placed on the jaws only. The anterior dorsal fin has three or four flexible spines. The species are rather numerous, inhabiting the temperate seas of the Old World. They are all small and beautifully ornamented. The ornamentation changes with age and sex, being most brilliant in the mature males, which also have the fin-rays prolonged into filaments. On the British coast is found the Gemmeous Dragonet or Skulpin (*Callionymus lyra*). The prevailing hue of this species is yellow of various shades, with sapphirine stripes and spots on the head and sides of the body. The ventral and caudal fins are bluish black. This species is common in various parts of our own coast as well as that of Ireland. It also occurs in several places in the Mediterranean, and also in different parts of the coast of Norway.

DRAGONET'TI, DOMENI'CO, the most famous of all performers on the contrabasso (double bass), was born in 1755 at Venice. He played in the orchestra of the theatre there at thirteen. He was soon engaged at St. Mark's Cathedral, and was so much admired that it was not till 1794 that he was permitted to leave the province. He came to London to play at the opera, and astonished every one by his performance, making his huge instrument take the lightest violoncello parts in concerted music, &c. He had composed a great deal of music for his instrument while in Italy. He may, indeed, be said to have discovered the full powers of the contrabasso. The eminent violoncello player Lindley was at that time in his prime, and for half a century did these two play together, inseparable companions, at the same music desk, according to the well-established custom of joining a violoncello to a contrabasso in the orchestra. Dragonetti frequently visited the Continent, was friendly with Haydn and with Beethoven,

but his home was henceforth in London. He played to the last, and died at London in 1846 at the advanced age of ninety-one.

DRAGON-FISHES (Pegasidæ) is a group of fishes whose natural affinities are not clearly understood. They are sometimes regarded as belonging to the order LOPHOBRANCHII. By the latest authority, Dr. Günther, they are doubtfully placed among the ACANTHOPTERYGII, next the armed gurnards (Cataphracti), of which the flying gurnard is an example. There is only one genus, containing four species, from the Indian, Chinese, and Australian seas. The body is entirely covered with bony plates, which are blended together on the trunk, but movable on the tail. The pectoral fins are large and strong, not unlike a bat's wing in shape. They are composed of simple rays, some of which are sometimes spinous. The snout is elongated. The mouth is toothless. The vertebræ are thin, and there are no ribs. The nature of the gills, which are four in number and have the ordinary laminate character found in the Teleostean fishes, separates this group at once from the Lophobranchii. The Common Dragon-fish or Sea-dragon (*Pegasus draconis*), figured in Plate II., ACANTHOPTERYGII, is common in the Indian Ocean. Three other species are known—*Pegasus volans*, *Pegasus natans*, and *Pegasus lancifer*, the last two having a more elongated body. All the species are of small size, and live on sandy shoal-places near the coast.

DRAGON-FLY is a common name for a well-defined group of insects, the genus Libellula of Linnæus. The position of this group in a systematic classification of insects is somewhat uncertain; they may, however, most conveniently be regarded as forming a suborder (to which the name Odonata has been given) of NEUROPTERA. Their beauty has gained for them among the French the name "Demoiselles," and the formidable powers of biting and stinging which they are popularly supposed to possess, the name "horse-stingers" in some parts of England, and "devil's darning needles" in the United States. Harmless as they are to man and the larger animals, to the weaker members of their own class, insects, they prove, both in the imperfect and perfect condition, merciless tyrants. The perfect dragon-fly is a monster of ferocity and voracity. He hunts and captures his prey on the wing, devouring even large butterflies; nor does he refuse to give battle to a wasp. He is not satisfied with sucking the blood of his victims, but devours them entire, rejecting the hard portions in the ordinary way in the shape of pellets. The dragon-fly in its imperfect condition has a special contrivance to secure its prey. This consists of the "mask," a peculiar modification of the lower lip (*labium*). The basal part, the chin (*mentum*), is elongated and slender; to this is articulated the labium proper, which is very large and dilated to its extremity, and bears a pair of palpi, which are usually powerful forceps. This mask is very large, and when at rest entirely covers the mouth. When the animal is about to seize its prey this apparatus can be shot out, in some cases to a distance of half an inch, in front of the head.

Returning to the perfect insect, the wings, four in number, are nearly equal in size and form—a beautiful piece of network, which resembles the finest lace, with the meshes between filled with a transparent glossy membrane. Some of the genera have wings always expanded, even when the creatures are resting, so that they can on being disturbed take flight in an instant, there being no necessity for them to unfold their wings. These insects can fly in all directions without turning—backwards and forwards, and to the right or left, so that to those inexperienced in their habits they are very difficult of capture. The smaller dragon-flies are equally alert. Specimens are sometimes taken at sea at great distances from land—more than 600 miles in one instance. The body is long and slender. The head is large and very freely attached to the thorax. The antennæ are short and bristly, consisting at most of seven joints. The eyes are very large; three small ocelli are also present. The jaws are very strong, and when at rest are covered by the upper lip. The prothorax is very small, consisting only of a narrow ring; the rest of the thorax is large. The legs are long and slender. The abdomen varies in form, being broad and somewhat flattened in a common British dragon-fly (*Libellula depressa*), and in others extremely long and thread-like; all gradations between the two extremes are found. It ends in the male in two curved, in the female in two simple, appendages.

The pairing of the sexes takes place in the air. The female lays her eggs in the water of lakes, rivers, &c. The larvæ, as before noticed, are remarkable for their predaceous habits. They pass insensibly into the pupa state by numerous moults, with no change of habits, and but little of form except as regards size. When the pupa has attained its full size it crawls up the stem of a water-plant a few inches above the surface. Here it remains till the skin splits longitudinally down the back, and the head and thorax, with a bit of the abdomen, of the perfect insect are drawn out, the head hanging downward. At this stage the body is suddenly curved forward and upward, the legs of the perfect insect now grasping the anterior part of the pupa case, which still retains its original attachment. The rest of the abdomen is now drawn out, and is seen to be already long and slender as compared with the case which contained it. The wings are still very small, but even as the dragon-fly stands clinging to its case an increase in size is noticed. Suddenly it leaves the pupa-case and walks rapidly up the stalk of the plant for a little way. The abdomen becomes inflated, and the wings can be seen growing, the actual motion being apparent. This may be done several times till the wings are full grown, the abdomen after each walk regaining its usual shape. The probable explanation of this curious phenomenon is that "by the exercise of walking respiration is quickened and the air-vessels in the abdomen are filled with air, which is expelled thence, possibly by a voluntary muscular contraction, into the wings, and by filling the vessels which run through the wing-nerves, stretches the wing to its full size" (Staveley, "British Insects").

Dragon-flies have almost a world-wide distribution. They are not found, however, in the Polar regions, and are most abundant in the tropics. About fifty species are found in England. They are usually divided into three families—Agrionidæ, Libellulidæ, and Æschnidæ—all of which find representatives in this country. Many of them are of great beauty, the species of the genera Agrion and Calepteryx bearing off the palm. The Great Dragon-fly (*Æschna grandis*) is the largest of the British species, being nearly 3 inches in length. Some Brazilian species, however, attain a length of nearly 7 inches.

DRAGONNADES (Fr. from *dragon*, a dragoon), the name given to certain infamous persecutions instituted in France for the forcible conversion of the Huguenots to Roman Catholicism during the latter part of the seventeenth century, in the reign of Louis XIV. The first experiment of the kind was made in the province of Poitou in 1681, a regiment of cavalry being sent into the province to be quartered upon those Protestants who refused to forsake their religion. The cruelty and violence of these men proved so effectual that similar measures were adopted in Bearn, Languedoc, Guienne, Angoumois, and finally in every province where the Huguenots had obtained a foothold. Everywhere the troopers were encouraged to plunder and destroy the property of those upon whom they were quartered, and to use both menaces and torture to induce conversion. As those who professed to be converted were

exempted from the quartering of soldiers for two years large numbers went over to the Roman Catholic Church, and the clergy of the latter, who had carefully concealed the real state of things from the king, found but little difficulty in obtaining from him in 1685 the revocation of the Edict of Nantes (1598) and the Edict of Grace (Nimes, 1629). The cavalry then undertook to suppress all gatherings of the Protestants into assemblies or conventicles, and though every effort was made to prevent it, a wholesale emigration of the Huguenots took place, 80,000 settling in London alone during the ten years that followed these events. In France the dragonnades appear to have been continued to some extent until 1750.

DRAGON'S BLOOD is a resinous product of various plants. The chief source is a palm, *Calamus Draco*, a native of the Malay Archipelago. The ripe fruits are covered with a reddish-brown, dry, resinous substance. In this state they are collected and allowed to remain till the resin drops off. The resin is afterwards melted, either by the natural warmth of the air or by artificial heat, and then moulded into the different forms in which it occurs in commerce. Sometimes the ripe fruits are shaken into bags, and the resin so obtained is formed into pieces about the size of beans, which are then wrapped up in leaves; this is a kind much prized in the East Indies. An inferior kind is obtained from the fruits thus treated being exposed to the heat of the sun or a slow fire, and the exudation formed into small cakes. What remains after these processes is run out, and forms a very inferior kind. The best kinds occur in rods about 1 or 1½ foot long, about the thickness of the finger, covered with the fronds of the palm; this is the "dragon's blood in reeds" of pharmacy (*sanguis draconis in baculis*). At one time this resin was considered astringent, and used medicinally; but it has been shown that it does not possess astringent properties, and its use is now confined to colouring plasters, tooth powder, and varnishes.

A very much smaller supply of "drop dragon's blood" is collected from *Dracæna Cinnabari*, a tree belonging to the Lily order (Liliaceæ), and a native of the isle of Socotra. Professor Bayley Balfour, who was sent out to investigate the natural productions of this interesting island, has fully reported upon the native dragon's blood. "The Socotran gum resin is the old *kinnabari* mentioned by Dioscorides. It is known on the island as 'edah;' among the Arabs it is 'kâtir.' The plant is endemic, and nearly allied to *Dracæna Draco* of Teneriffe. From the other gum-resin producing species, *Dracæna Ombet* of Abyssinia, and *Dracæna schizantha* of Somali-land, of which we have as yet but imperfect knowledge, it is apparently quite distinct. The gum resin exudes in tears from the stem of the tree, and is collected after the rains, the gatherer chipping off the tears into goat-skins. There are three forms in which the gum resin is exported. Of these 'edah amsello'—the tears as they exude from the tree—is the purest and most valuable form; 2¼ lbs. fetch one dollar. The second best kind is called 'edah dukkah.' It consists of the small chips and fragments of the tears which have been broken off in separating the gum tears from the tree or by attrition; it sells at one dollar for 4 lbs. The cheapest is the 'edah mukdehah,' which brings one dollar for 5 lbs., and is very impure. It is in the form of small flat-sided masses, and consists of fragments of gum resin and refuse of the gatherings melted together into a flat cake, and then broken up into smaller portions."

Another source of dragon's blood is *Dracæna Draco*, a native of the Canary Islands. It is collected from the cracks made by gashing the trunk; and being tonic and astringent, it has been used in diarrhœa and passive hæmorrhages. This resin has been found in the caves in which the native Guanches buried their dead, and it is supposed that they used it in embalming. Another tree that yields dragon's blood is *Pterocarpus Draco*, one of the Leguminosæ. The resins obtained from the two last-mentioned sources do not find their way into European markets. See CALAMUS, DRACÆNA.

DRAGOON' (Fr. *dragon*), a name originally given to a troop of light cavalry raised by Marshal Brissac in the year 1600. The title seems to be derived from the circumstance that the carbine carried by these troops had the figure of a dragon's head worked upon the muzzle. At one period the name dragoon was used to indicate a soldier trained to fight either on foot or on horseback, and regiments trained in this way still form part of some of the continental armies. In the British army the dragoon is purely a cavalry soldier, the regiments being divided into *heavy* and *light* according to the weight of the men, horses, and appointments. The men are armed with breech-loading carbines, sabres, and pistols or revolvers, but the sabre is still regarded as the chief weapon.

DRAGUIGNAN, the capital of the French department of Var, stands on the river Artubie, 490 miles S.E. from Paris, and has 9000 inhabitants. The town is situated in a fertile plain surrounded by an amphitheatre of hills covered with vines and olive-trees. It is tolerably well built, ornamented with numerous fountains and many rows of trees, and traversed by a canal from the Artubie, which moves the machinery of several factories. The chief buildings are — the court-house, the prison, the clock tower, which is built on the summit of a high rock, and the hospital. The inhabitants manufacture coarse woollens, soap, olive oil, leather, stockings, silks, wax-candles, and earthenware. The environs produce excellent fruit and wines. The town has tribunals of first instance and of commerce, a college, a library, a cabinet of medals, a museum of natural history, and a botanic garden rich in exotic plants and beautifully laid out.

DRAINAGE, METROPOLITAN MAIN. Until the year 1847 the sewers of London were managed by eight separate commissions of sewers. The surveyor of each carried out his own particular views, regardless of his neighbour, and the result was most unsatisfactory, for such a system naturally led to great inconvenience and a wasteful expenditure of public money. Eventually seven of the commissions were consolidated into one, the City Commission still remaining separate. The new commission, called the Metropolitan Commission of Sewers, was appointed in the above-mentioned year, but it has since been succeeded by the Metropolitan Board of Works. In 1848 people began to remonstrate against the evils arising from the discharge of sewage into the Thames, and to urge the importance of the purification of that river. At that time, however, the public mind was not generally prepared for a bold and comprehensive remedy; but the matter daily became more urgent, and various plans were from time to time devised to remove the evil. That which was ultimately adopted was proposed by Mr. J. W. Bazalgette, the engineer to the Metropolitan Board of Works, and commenced in February, 1859. It would require a volume to give a detailed description of all the immense works connected with the scheme, but some of the more important portions of them may be briefly described. In preparing his plans Mr. Bazalgette had two great objects in view—to relieve the low-lying districts from floods and the evils incident to a tide-locked drainage (for many of the old sewers, particularly on the south side of the river, were several feet below high-water mark, and could discharge their contents only at low water), and to purify the Thames to the greatest possible extent. Another important object was to provide for the conveyance of the sewage to the final outfall by gravitation, thus making the drainage self-acting, and avoiding, as far as possible, the use of artificial means. Accordingly, he has divided the north

side of the river into three distinct drainage areas, called respectively the high-level, the middle-level, and the low-level. Each district is separated from the one below it by a gigantic conduit, which, running generally from east to west, and cutting all existing sewers at right angles, intercepts the sewage in its flow to the Thames, and carries it away far below the city. The high-level sewer is 9 miles in length, and its diameter, which commences at 4 feet, is gradually increased to 12 feet, as the intercepted sewage requires a wider channel. The depth below ground is from 30 to 50 feet, and the inclination is such as to secure a velocity of about 3 miles an hour, which is considered by the best authorities as more than sufficient to make the drain self-cleansing. The head of the sewer is at Hampstead, whence it runs due east through the fields to Stoke Newington, intercepting both the Fleet and the Hackney Brook, and it then proceeds in a south-easterly direction to Old Ford, on the river Lea. At that point, after draining an area of 10 square miles, it forms a junction with the middle-level sewer. The latter extends from Kensal Green, passing along the Uxbridge Road and Oxford Street, and thence through Clerkenwell and Bethnal Green to Old Ford, and, with its branches, is upwards of 12 miles in length, draining an area of 17 square miles. It varies in size from 4 to 12 feet in diameter, in depth from 50 to 60 feet, and the rate of inclination ranges from 2 to 18 feet per mile. From Old Ford the combined sewage of the high and middle level areas is carried downward in a double conduit to Abbey Mills, which is the point of junction with the low-level sewer. The low-level sewer follows as closely as possible the course of the river from Chelsea to Blackwall, and is then turned in a north-easterly direction to Abbey Mills, where its sewage, collected from an area of 11 square miles, is raised, by pumping, to the upper levels, and from that point the whole sewage of London north of the Thames, with a slight exception, flows by gravitation through three parallel drains, each 9 feet in diameter, to the final outfall at Barking Creek, about 11 miles from London Bridge. In this scheme adequate provision was made for storms and sudden falls of rain. The drainage of the western districts, on the north side of the river, including Acton, Hammersmith, and Fulham, and comprehending about 21 square miles, is intersected by a sewer running eastward from Chiswick Mall through Walham Green and along the banks of the Thames to a pumping station at Pimlico, where the sewage is lifted into the low-level sewer above described, and carried thereby to the second pumping station at Abbey Mills. The size of the western sewers varies from 3 feet 9 inches × 2 feet 6 inches to 6 feet 9 inches. Their gradients are from 3 to 10 feet per mile, and they are at a depth of from 12 to 50 feet. The total length of these sewers is about 7 miles.

On the south side of the Thames works of a similar character have been constructed. The only difference is that the southern district has been divided into two areas of drainage, a high-level and a low-level, instead of three; but, on the other hand, what is called the high-level sewer consists of two lines—one from Clapham to New Cross, forming a middle-level sewer; and the other from Dulwich to New Cross, being a high-level sewer. From that point they are carried in the same trench, but at different levels, to Deptford. Here they discharge their storm waters through two sewers, each 10½ feet in diameter, and the sewage is conveyed by four lines of iron pipes under the Creek into the outfall sewer by gravitation. The high-level sewer drains an area of 20 square miles, embracing Dulwich, Clapham, Camberwell, and Peckham, and it has an inclination varying from 2½ to 50 feet per mile. The low-level sewer takes its rise near Wandsworth, thence it runs through Wandsworth and Battersea-fields to the Brixton Road, and so on through the low-level districts to Deptford, where its waters are raised to the high-level sewer. It drains an area of 22 square miles. From the pumping station at Deptford the entire sewage of London, south of the Thames, is carried in a conduit of 11½ feet in diameter by Greenwich to Woolwich, and thence over the Erith marshes to a pumping station at Crossness, where it is lifted into a storage reservoir, and discharged into the river at high water.

The above, of course, is a mere outline of the London Main Drainage Scheme. No mention has been made of branch drains, extending many miles in length, and conveying the sewage of remote isolated districts to the great intercepting sewers. Enough, however, has been said to show that the scheme is one of unexampled magnitude. It provides for the drainage of a total area of 101 square miles, involving the construction of more than 70 miles of intercepting sewers, nearly all underground, of upwards of 12 miles of colossal outfall sewers, and of a large number of bridges, pumping stations, and reservoirs—themselves works of no ordinary kind. The original estimate was about £3,000,000, but in consequence of the rise in the price of bricks and other building materials, caused by the increased demand created by these and other extensive works, the actual cost was considerably more; and it was necessary to expend a large sum in improving the old main lines of sewers, and covering all open streams, before the London drainage could be pronounced perfect.

At the outfalls the sewage, according to the original plan, was to have been cast into the bottom of the river during the first two hours of the ebb tide only. The period of discharge was restricted to those hours, because then the sewage would have been deodorized and diluted by a volume of water twenty times greater than that which formerly diluted it at London; and because each ebb tide would, in returning to the sea, convey it to points 12 miles below the outfalls, or 26 miles below London Bridge, through a constantly enlarging flood. But many careful observers are convinced (against the opinion of the majority, it is true) that the river was never clear of sewage—a large section of the stream being always full, and poisoning the air as the tide hustled it to and fro.

The main drainage was not actually finished until 1875. The portions connected with the Chelsea embankment and the western pumping station were the last parts completed. The pumping station is close by the Thames at Pimlico, where the sewage of the district is raised 18 feet into the low-level sewer, which carries the drainage to the pumping station at Abbey Mills, where it is again lifted into the outfall sewer, by which it is conveyed to Barking Creek.

In the twenty-one years between 1856 and 1876 nearly 500 miles of sewers were made in the metropolis, under the direction of Mr. Bazalgette, at a cost of £7,000,000. This is in addition to 800 miles of connecting sewers which were laid by local boards and vestries. Drains 1300 miles long are sufficiently surprising, but it is only when we recollect the largeness of scale, the engineering difficulties which had to be surmounted, and the solid manner in which the great sewers have been constructed, that we can fairly comprehend the magnitude of the work that has been accomplished. Two things only are now wanting in this connection to satisfy the sanitary arrangements of the metropolis. One is, that the sewage shall not continue to be emptied into the Thames, to pollute and poison the stream, but be turned to profitable use on the land; the other, that the water supply shall be rendered pure and adequate to the requirements of the population. As regards the first point, the marked increase of fish in the metropolitan portion of the river, and the decided decrease of offensiveness during the summer, are clear proofs of its improved state.

DRAINING. See AGRICULTURE.

DRAININGS, in rural economy, is a term applied to the flowing of urine or any excrementitious, feculent, or putrescent liquids into the common dung-heap of the farmyard. The application of drainings to compost heaps is now extensively practised both by scientific and practical farmers; and those who neglect this provision sustain material loss by being driven to the necessity of making expensive purchases of manure both at home and abroad. But, as it has been judiciously observed by a German writer on agricultural chemistry, "the farmer who buys guano, bone-dust, or other artificial manures, but does not look carefully after his drainings, is extravagant; for he brings the same thing into his yard at great cost which he might have for nothing if he did not suffer it to flow or evaporate uselessly away from the same. That drainings fertilize the soil every farmer must be aware even from childhood, but how great is their power in this respect, and how much of this power may be lost by careless preservation and treatment, many farmers do not yet know. Were it otherwise, draining-tanks, commodiously placed, would be provided in every farmyard; one would no longer find on a farm great puddles of dungy and urinous drainings, or brown currents of liquid guano streaming forth from every farm inclosure, to be lost in the gutters or village pond."

The great manuring value of drainings arises principally from the quantity of nitrogen and potash contained therein. We find that in the twelve months' drainings of a cow there exists as much of nitrogen as is to be found in 5 cwts. of the best guano; and of potash, about 1½ cwt. Moreover, if these twelve months' drainings were collected and dried, it has been computed that about 6 cwts. of solid extract might be obtained from them, which in fertilizing power would be equal to the best South American guano.

In the collecting of compost heaps and the application of drainings all the refuse matters connected with a farm may be profitably made use of; such as soap-suds, dish-water, blood, ashes, soot, peat-dust, sawdust, rubbish, sweepings of mud, dirt, &c. These heaps may be kept moist by being frequently saturated with urine; and it will be found that when its watery portions have evaporated the ammoniacal combinations produced by its nitrogen are still retained, partly by the earth and partly in the humus. The process of fermentation is materially accelerated by occasionally stirring up the mass. Thus by the accumulation of such compost heaps the farmer is able to secure considerable advantages from the employment of many substances and liquids which are ordinarily thrown away or allowed to remain as nuisances on his farmstead.

DRAKE, SIR FRANCIS, was born in or about the year 1546, in Devonshire. His father, who was exposed to some persecution as a Protestant during the reign of Mary, retired with his family to Kent, was ordained, and became vicar of Upnor, on the Medway, near Chatham. Francis thus grew up among sailors, and while he was yet very young was apprenticed to a neighbour, the master of a bark, who carried on a coasting trade, and sometimes made voyages to Zealand and France. This man on his death, having no children of his own, bequeathed to young Drake the bark and its equipments. Drake, however, soon sold his ship, and embarked himself and his fortunes in Sir John Hawkins' last and unfortunate adventure to the Spanish Main. Drake lost all his property, but acquired a character for skill and courage, having brought safe home the bark which he commanded, a vessel of 50 tons. Desirous of revenging himself upon the Spaniards, and being joined by a number of sea adventurers, who mustered among them money enough to fit out a vessel, Drake made two or three voyages to the West Indies to gain intelligence and learn the navigation of these parts; but Camden adds that he also got some store of money there, "by playing the seaman and the pirate." In 1570 he obtained a regular commission from Queen Elizabeth, and cruised to some purpose in the West Indies. In 1572 he sailed again for the Spanish Main with the *Pasha*, of 70 tons, and the *Swan*, of 25 tons, the united crews of which amounted to seventy-three men and boys. He was joined off the coast of South America by another bark from the Isle of Wight, with thirty-eight men; and with this insignificant force he took and plundered the town of Nombre de Dios, and made great spoil among the Spanish shipping. After some extraordinary adventures Drake returned to England with his frail barks absolutely loaded and crammed with treasure and plundered merchandise, and on the 9th of August, 1573, anchored at Plymouth.

Drake was employed for a time in the service of the queen in Ireland; but in 1577, under the secret sanction of Queen Elizabeth, he departed on another marauding expedition, taking with him five vessels, the largest of which was of 100 and the smallest of 15 tons. The united crews of this miniature fleet amounted to 164 men, *gentlemen* and sailors. After many adventures along the coasts of the South American continent, where some of his attacks were completely successful, Drake, on 20th August, reached Cape Virgenes, and sailed through the Strait of Magellan, being the third navigator who performed that passage. On the seventeenth day after making Cape Virgenes he cleared the strait and entered the Pacific or South Sea. Having obtained an immense booty by plundering the Spanish towns on the coast of Chili and Peru, and by taking, among many other vessels, a royal galleon called the *Cacafuego*, richly laden with plate, he sailed to the north in the hope of finding a passage back to the Atlantic a little above California. After reaching 48° N. lat. the severity of the cold induced him to alter his intentions, and he determined to follow the example of Magellan and steer across the Pacific for the Moluccas. He thence reached Plymouth by Java and the Cape of Good Hope, on 26th September, 1579, having circumnavigated the globe and spent many months on the almost unknown south-western coasts of America. Drake was most graciously received at court, and Elizabeth partook of a banquet on board the vessel, and there knighted the captain. During part of the year 1585, and the whole of 1586, Drake was actively employed against Philip II. on the coasts of Spain and Portugal, in the Canaries, the Cape Verds, the West India Islands, and on the coast of South America, where Carthagena and other towns were taken and plundered.

In 1587, when formidable preparations were making in the Spanish ports for the invasion of England, Elizabeth appointed Drake to the command of a fleet equipped for the purpose of destroying the enemy's ships in their own harbours, which service was very effectively performed. He destroyed four castles and a great number of vessels of all sorts on the coast from Cadiz to the Tagus, and this he called "singeing the King of Spain's beard." These operations delayed the sailing of the armament more than a year, and gave Elizabeth time to prepare for her defence. Having thus performed the public service Drake bore away to the Azores, on the lookout for the treasure ships from India, and he was so fortunate as to fall in with an immense carrack most richly laden. He took it of course, and he generously spent a considerable part of his prize-money in supplying the town of Plymouth with good fresh water, for hitherto there was none, except what the inhabitants fetched from a mile's distance.

His next service at sea was as vice-admiral in the fleet under Charles Lord Howard of Effingham, lord high admiral of England, which, with the assistance of the elements, scattered and destroyed the "Invincible Armada" of Spain. [See ARMADA.] The seamanship of Drake, Hawkins, and Frobisher contributed largely to the happy result. In the following year, 1589, Drake was employed as admiral in an unsuccessful expedition sent to Portugal to support the claims of Antonio, a pretender, against the sovereignty

assumed by the Spaniards. In 1595 Drake and Sir John Hawkins, with a land force under the orders of Sir Thomas Baskerville and Sir Nicholas Clifford, were sent with twenty-six ships to attack the Spaniards in the West Indies. When they got among the West India Islands Drake and Hawkins quarrelled, and before reaching the east end of Puerto Rico Hawkins died. Drake attacked Puerto Rico, and was defeated. Sailing away he took and burned Rio de la Hacha, Rancheria, Santa Martha, and Nombre de Dios, but gained little booty. Drake remained in the harbour of Nombre de Dios, while Baskerville made a vain and ruinous attempt to cross the Isthmus of Darien. A fatal disease broke out among the soldiers and sailors, and many of his men and three of his captains died. Drake himself fell sick, and expired on 27th December, 1595, in sight of Puerto Bello, which he had formerly taken and plundered.

DRAMA (Gr. *drama*, action). The drama or dramatic art is that art which exhibits human actions by means of language and theatrical representation. It is not easy to define what human actions, or what connected series of human actions, are adapted for dramatic purposes, that is, for representation on the stage; for if the dialogue is so far detached from action as to be capable of no further representation than that of two or more persons expressing in conversation that which is written, there is no drama in the sense of the term which we are now considering. In order to fix the attention of a great number of spectators there must be some plot-interest which commands the sympathies of all, some series of events in which human passions are developed, some catastrophe or end which is so connected with the preceding events as to be in the nature of a consequence, possible or probable; and the whole must be comprehended within such limits of time that the audience may not be wearied. For entertainment some pleasurable sensation, though it may be mingled with pain, is essential to make dramatic representation successful.

The distinction of the drama into tragic and comic, or the representation of human suffering and violent passion, of constancy in misfortune, of poetical and heroic actions against opposing fate, and the representation of love intrigues, ludicrous adventures, laughable positions, the follies and little incidents of domestic life, is not an essential distinction. The drama, whether tragic or comic, is still the exhibition of human life under some aspect. The ultimate purpose, as of all literary efforts and of all art, is moral; to exalt, to purify, and to correct. The dramatist who best fulfils the end of his intellectual activity is not absorbed in his own feelings, from which he must detach himself as much as possible; he must renounce his own individuality in order to contemplate the individuality of others, and the modes in which human beings act when they come in contact with each other. It is true that he whose intellectual and moral constitution is not both comprehensive and varied, can have little knowledge of, and less sympathy with, the universal mind and passions of man, and cannot therefore view them as dramatic objects; but it is no less true that he must be able to look on others out of himself, and use his own understanding and passions as a key to the interpretation of the diversified scenes of human activity. Shakspeare, the greatest dramatist who ever lived, leaves us in almost entire doubt as to his own character, taste, politics, and religion.

The taste for dramatic representation is universal, though the representation itself may be varied infinitely; and some nations perhaps have never had anything to which we can give the name of a drama. We cannot therefore attribute the invention of the drama to any one nation. That of the Hindus is quite independent of the drama of the Greeks. But as European civilization must be traced back to that of Greece and Rome, so the drama of modern Europe has its ultimate origin in the dramatic literature of Greece and Rome, the "mysteries" and "moralities" of the middle ages having failed to produce a fresh school, and having had the ancient principles engrafted on their wild stock, to use a figure, when the long sleep of the dark ages yielded to the awakening of the Renascence.

The ancient drama, containing dialogue, chorus, speech, and song, which was one of the most perfect art-forms ever developed, and which still largely influences our stage, is so important a theme as to demand an article to itself. Under GREEK DRAMA, therefore, the reader will find a full account of this subject. The Roman drama was so exact a copy of the Greek in form, and often in words also (Plautus and Terence for the most part simply translating from Menander and other Greeks), that it is included in the same article. It seems necessary, however, to add here a few brief sketches of the history of the drama among the leading modern nations. After the downfall of the ancient civilization, in the general extinction of polite literature and liberal art which darkened for so many centuries the moral face of Europe, every trace of truly dramatic performance or composition seems to have disappeared. The Saturnalian pageants—the Feast of Fools, the Feast of the Ass, &c.—exhibited during the long interval of the dark ages, chiefly at the Christmas and New Year festivities, alone in some degree filled the place of the old theatrical portion of the religious celebrations. To arrive once more at any indication of the general existence of what can with propriety be called a religious drama, we must descend to a later period of European history.

In *England*, as in ancient Greece, the native drama arose from religion; and it is possible that had it not been for the influence of the Renascence, and the consequent return to classic models, a new and finely national type of drama might have now been flourishing among us. The English miracle-plays and mysteries arose during the fourteenth and fifteenth centuries. They were the good-natured attempts of the monks to bring vividly before the people, in the form of dialogues between the sacred personages, the main parts of the Bible narrative. In the dense ignorance that prevailed such presentations were the only true method of touching the lower classes. The response was immediate and enthusiastic. The perennial dramatic instinct was satisfied, and what began from a holy motive was continued for the sake of the hearty pleasure found in it by all. In remote parts of the Continent these miracle-plays yet continue, as in Tyrol and Bavaria (at Ober-Ammergau, &c.), and the Christ or the Virgin of the stage passes through life with some dim mysterious reflection of the sanctity assumed on the stage still clinging to him. Joseph Mayer, the "Christ" of the Ober-Ammergau play about 1875, was an often-described example of this pseudo-identification of the actor with the spirit of the character he represents among primitive peoples. So it was in old England with the "saints" of the miracle-plays and the personages of the Bible mysteries. As people advanced in knowledge, however, this original reverence for the strange life-giving art fell off; monks and neighbours were known for such, and the humours of the times were freely introduced, till many of the sacred stories were almost travestied. The reader of this curious literature (very interesting, moreover, if full license to "skip" be accorded) will usually find Noah's wife a broadly comic person, and can usually perceive heroic efforts on the part of the ancient monkish scribe to make his demons mirth-giving creations. It was not a difficult step from the "mysteries" to the "moralities," wherein the leading characters were no longer persons but passions, vices, and virtues; sometimes under their own name, as Folly, Avarice, Vice, &c., sometimes under conventional names, as Brutus (Liberty), Aristides (Justice), &c. Hence at last arose an English

comic drama, for in 1550 or thereabouts (it was published in 1566) the headmaster of Eton, Nicholas Udall, bringing into a rough imitation of Terence's form, familiar to him as a scholar, the comic elements in the "moralities," produced "Ralph Roister Doister," the first composition in English worthy of being called a play. It is a succession of farcical scenes, divided into acts on the Roman (*i.e.* the Greek) model, and probably was written for the boys to act at their festivals. Not long afterwards appeared the first English tragedy, "Gorboduc," by Sackville and Mrs. Norton, acted in 1562. It followed classical models and seems to us dull and heavy, being full of terribly long speeches, but in its time it was considered admirable. It must have seemed an extraordinary novelty in the form of its versification, for it is in blank verse, then a quite new form of writing. The new art thus opened did not lack followers. Lyly improved vastly upon Sackville, and Marlowe outshone Lyly. Indeed, such an outburst as that of Marlowe in England is paralleled only by the sudden splendour of Æschylus among the Greeks. From Lyly, whom none but a few diligent students now have patience to read, we are plunged at one step into poetry abounding in passages which are worthy of Shakspeare. [See MARLOWE.] Greene, Nash, and Peele, men of great and original minds but of very loose lives, and of only temporary influence in the school, succeeded Marlowe, but almost contemporary with them was the immortal Shakspeare (Peele was born in 1558, Greene in 1560, Shakspeare in 1564), and as soon as that gigantic power turned from the world of poetry, enriched by "Venus and Adonis," "Lucrece," and the earlier sonnets, to seek its proper sphere in the wide range of the drama, all the lesser lights paled. It is astounding to think that Marlowe could almost be said to be the first English dramatist and Shakspeare the second (Shakspeare was twenty-eight, and on the point of publishing "Venus and Adonis," when Marlowe perished in a tavern brawl), and that our drama sprang to such perfection at one bound. Shakspeare became an actor, and his plays are for the most part re-writings of the stock pieces of his company. His knowledge of stage necessities and his dramatic and poetic genius combined to form the world's wonder that we know. He is known to have played the ghost in "Hamlet," and Adam in "As you Like It," but does not seem to have risen to any great height of public favour as an actor.

Shakspeare's contemporaries would be esteemed giants if his own colossal splendour did not overtop them. George Chapman, Ben Jonson ("O rare Ben Jonson!"), and the friends and co-workers Beaumont and Fletcher, are more esteemed year by year. Their fancy, exuberant to faultiness, their crowded ideas and images, their fine wit and their genial adventurous spirit, play like free mountain breezes around one who turns to them from Johnson and Addison. It was the palmy time of the English drama. For the separate achievements of these poets the reader is referred to the respective articles upon each of them. Webster, Ford, Massinger, and Shirley closed this grand epoch. As Charles Lamb says in his "Specimens," still the best general introduction to the Elizabethan drama we possess, these men "spoke nearly the same language, and had a set of feelings and moral notions in common." Puritanism absorbed the energies of the nation, and the drama of the stage gave way to the excitement of the rapidly changing scenes of real life. With the Restoration the stage again reared its head. Formally suppressed by the rigid Puritans, it rebounded into license on regaining its freedom. Just at first it took a rather extraordinary turn, for the king and his gentlemen having spent their lives in France, saturated with the style of Corneille and Racine, Sir William Davenant endeavoured to imitate the grandiose periods of those somewhat frigid writers, and even condescended to remodel Shakspeare in that style! Dryden introduced the rhymed tragedy in still closer imitation of the French, defending it formally in his celebrated pamphlet of 1668 on "Dramatic Poesy." The result was one of the most amusing works in the language, the witty Buckingham's "Rehearsal," when Dryden, snuffbox in hand, voice, gesture, and expletives all carefully studied by the arch-mimic, was made to superintend the rehearsal of a rhymed tragedy ("The Two Kings of Brentford") under the character of Bayes. The nickname stuck to him through life, and rhymed tragedy was crushed once and for all. In tragedy Dryden was succeeded by Otway, Lee, and Rowe. It is painful to look at the next step in our drama—the full unmitigated result of the open licentiousness of Charles' court, when once the elder grave survivors of the great Puritan epoch had died away. Wycherly, Congreve, Farquhar, Vanbrugh, into what a terrible sink of obscenity their genius had been plunged! Worse than anything else, the freedom which the Elizabethan dramatists had taken with women's parts occasionally, since every one knew that they were played by boys, was not only made the rule instead of the exception, but was converted from indecency into obscenity by actresses for the first time appearing on the stage. It has taken from that day till our own for the stage to recover its proper character as an honourable career for a pure-minded noble woman, so deeply did it sink in the times of Nell Gwynne and "Bracegirdle the Brown." The gallants of the time, for the better view of the actresses' charms, sat upon the stage itself, and sometimes did not scruple to address them even in that public place (see "Pepys' Diary," &c.) But our own are better times in this respect, and it now only depends upon an actor's or an actress's own character whether their profession is to ennoble or to endanger their virtue. Lamb's defence of his enjoyment of these Charles II. writers is in itself a crushing satire. He says of Congreve (one of the best) that "he has spread a privation of moral light, I will call it—rather than by the ugly name of palpable darkness—over his creations. No decent character is to be found, consequently, all being alike improper and unnatural, one looks on without the moral judgment coming into play, as at a puppet-show." It may be so, but this group is a lasting disgrace to our history. It was checked suddenly by Jeremy Collier, a man of no particular talent or merit, but so penetrated with disgust at the stage of his day, that his "Short View of the Profaneness, &c.," published in 1698, brought the rush of filth to a close. Dryden, who had soiled his fame by yielding to the demands of the court for loose comedies, at once kissed the rod:—"If he be my enemy let him triumph, if he be my friend he will be glad of my repentance. It becomes me not to draw my pen in defence of a bad cause, when I have so often drawn it for a good one." Vanbrugh and Congreve tried to reply, but the jests stuck in their throat. It needed a generation before light comedy could revive from its merited downfall, and then Goldsmith, and better still, Sheridan, with all the wit and more, and with none of the indecency, began the modern comedy of manners. The latter's "Rivals," and his yet finer "School for Scandal," are masterpieces as fresh now as the day they were written. Less brilliant, though almost as great favourites, are the "Good-natured Man" and "She Stoops to Conquer" of Oliver Goldsmith; and it is Sheridan, and not Goldsmith, who is the true heir of the "Restoration" comic dramatists.

The recoil from the vicious "Restoration" school was as violent and overstrained as was that school itself from Puritan thought. The heavy pomposity of Congreve, Addison, and Johnson make their once famous tragedies now unreadable. The third stage of our drama, critical, imitative, frigid, and lifeless, reached its culmination of absurdity when the poet Thomson could find no better lamentation over his heroine than the line—

"Oh Sophonisba, Sophonisba, oh!"

One admires the instant retort from the playhouse gallery with which a humble critic condemned the play, echoing the actor's line with an improvised imitation—

"Oh Jemmy Thomson, Jemmy Thomson, oh!"

Ridicule is indeed the only way to meet such offences against true art. It is hard to say why tragedy has sunk so low. Lord Byron in the last generation wrote some fine dramatic (but not stage) works, Coleridge produced for Drury Lane the second-rate "Remorse," but the attempts of Sheridan Knowles only serve to make "the darkness visible." Yet brighter times are surely at hand. Shakspeare is loved, honoured, and acted as never before—the main body of the people, and not only a few persons of taste, finding their chief delight in listening to his works. Lord Tennyson has delighted this generation with "The Cup," and it is to be confidently hoped that the audience being ready and fit, tragic poets will be forthcoming. Meanwhile light comedy found a remarkable and original writer in Robertson, who had many imitators, in the third quarter of this century, and melodrama, spectacle, and comic opera (wherein Gilbert and Sullivan bid fair to become as fixed a conjunction as Beaumont and Fletcher, *parvis componere magna*) have reached higher and purer flights than at any other period in England or among any of the contemporary continental nations.

England thus had the grand Elizabethan tragic and comic period, followed by the fine (though licentious) period of witty comedy of the "Restoration," and the all too brief burst of high comic power in the Georgian era. It is so with other nations; each has its one great dramatic period, and in many cases this is followed by a brief afterglow. We proceed as briefly as possible to indicate their times of power.

In *France* Corneille, under Louis XIV., shone forth in the middle of the seventeenth century as suddenly as did our Marlowe in Elizabeth's time, a century before. He was followed in his noble tragic vein by the more correct and classic, but rather frigid Racine (the slavishly obedient pupil of the critical Boileau), and in his fine comedy by Molière, whose originality and poetic power are equal to that of his predecessor, while his wit and fun are on all hands acknowledged to surpass that of any age or land. For over two centuries the world has laughed its heartiest with Molière, and it shows no sign of ceasing yet. Molière has had but one successor, Beaumarchais, whose "Barber of Seville" (middle of the eighteenth century), with its sequel, the "Marriage of Figaro," merits its world-wide renown, and is as fresh as ever to this day, preserving its rich humour even in the trying form of opera-libretto (both as Mozart's "Nozze di Figaro" and as Rossini's masterpiece, the "Barbiere di Siviglia"); and Corneille and Racine have likewise had but one successor, Voltaire. Voltaire's "theatre," however, is certainly his least successful work. The authority of Boileau and the classicists was overthrown in the second quarter of this century by Victor Hugo in a series of magnificent romantic dramas, "Hernani," "Ruy Blas," &c., setting the pattern for a fine outburst of poetical stage-writing, which has now given way to elaborately-worked comedies closely built upon contemporary manners. Dumas the Younger is the acknowledged leader of this last school.

In *Germany* Lessing is the great originator, at the close of the last century, both of tragedy and comedy. His "Nathan the Wise" is one of the plays of the world. But the glory of Germany is the immortal pair, Goethe and Schiller, whose "Faust" and "Wilhelm Tell" respectively are household words in every civilized nation. But this century, thus brilliantly inaugurated, has seen no German successor worthy of being named after these monarchs of the lyre.

In *Spain* the palmy period was rather before that of France. Lope de Vega (beyond all dramatists the most fertile) and his greater successor, Calderon, cover the first half of the seventeenth century. We may therefore class the great periods of the countries already named in the order of their occurrence—thus, England, Spain, France, Germany—and the succession is extremely close.

In *Italy* Metastasio's sentimental opera-libretti, and Goldoni's witty comedies in the Venetian dialect, illuminate the latter half of the eighteenth century with works of the highest merit in their several departments; and in Alfieri, second husband of the Countess of Albany (the lady's first husband having been the unhappy Charles Edward, the "Young Pretender"), the Italian stage at the close of last century possessed the only true tragic poet of the first order.

Therefore it is fair to say, speaking broadly, that the modern drama has extended but a little way into the present era. The nineteenth century, brilliant as it has been in science and the mechanical arts (and possibly *because* of this), has as yet no great names to show in this department of literature, the drama.

The great poet-musician Wagner, in his noble works from "Der Fliegende Holländer" (the Flying Dutchman) to "Parsifal," sought in our day to recreate the drama in the ancient Greek sense. In his view the poetry of literature, of music, of the pictorial arts (both of costume and painting), of gesture, and of oratory, should all again take part, as they did in the times of Æschylus and his successors in ancient Greece, to produce one great art-form, the only one fairly worthy of the name of drama. (See his pamphlet, "Oper und Drama," which set the world of music by the ears in the middle of the nineteenth century.) But when Wagner died in 1882 he left no successor. If we may reckon his grand works, as he wished them to be reckoned, under the heading of "dramas," then indeed the stage of the nineteenth century also has its glory in himself; but there will be few who will not consider that of all stage works those of Wagner have the least title to the name of drama, since plot-interest is oftentimes almost absent from them; and there will be probably none who will not class them as musical rather than as literary productions. By common consent they rank as a distinct class of the OPERA.

DRAM'MEN or **DRAM**, a seaport in Norway, in the amt of Buskerud, on the river Dram, which here enters the Drammenfiord, in the Gulf of Christiania. It has about 16,000 inhabitants. The town is divided into three quarters—Bragnaes on the northern, and Stroemsoe and Tangen on the southern bank of the river. These are united by a handsome bridge. Bragnaes consists of a row of houses about a mile in length. The principal trade consists in the export of timber and iron. Leather, tobacco, oil, sailcloth, &c., are manufactured. Shipbuilding is carried on. The harbour has depth sufficient to allow vessels to lie alongside the quays. The imports are salt, coals, wine, spirits, colonial produce, and manufactured goods. The town is noted for the manufacture of *carrioles*, or light tilt-carts. The women of Drammen are considered the greatest beauties in Norway.

DRAUGHTS, the name of a game played on a board divided into squares like chess, to which, however, as an intellectual exercise it is very inferior, although it has become very popular. Two parties play, each having a set of twelve "men," one black and the other white, but the whole of them must be played on squares of one colour; in England the white is generally chosen. Each player sits with what is called the "double corner" (*i.e.* the corner where two of his pieces are in close juxtaposition) on his right hand, and the men are moved alternately by each player, but only by one square at a time, and in a diagonal direction. A piece cannot be moved if an opponent's man stand in the way, unless there be a vacant square beyond into which it can be placed; when this is the case the

piece leaped over is taken and removed from the board. Several men may be taken in one move (or rather series of moves) if found with an open square between each two. If a player refuses to take a man, his own piece is "huffed" and removed from the board. Whichever party succeeds in taking all his adversary's men, of course, wins the game. If either player reaches the last line of squares on the opposite side of the board, that piece is called a "king," and "crowned" by placing another on the top of it. Kings may be moved either backwards or forwards (though, as before, only diagonally and one square at a time), and this additional power is a great advantage to the player who first obtains the greatest number of crowned heads, and in his favour the game usually ends. It holds much the same relation to chess that bagatelle does to billiards.

DRAVE, a river of Austria, which, rising in the Pustertbal, near Innichen, in the western part of the Tyrol, flows S.E. to Villach in Carinthia, whence it runs E. as far as Marburg in Styria; below this its course is S.E. along the northern border of Croatia and Slavonia, which it separates from Hungary, until it falls into the Danube, from the right bank, about 13 miles below Essek. The whole length of the Drave is about 360 miles. It becomes navigable at Villach. Its tributaries are the Mur, which joins it at Legrad, the Gail, the Gurk, Glan, Lavant, &c. The valley of the Drave above Warasdin in Croatia is narrow and hemmed in by high mountains, which in a few places, as at Seidlich and Kossig, approach within a few hundred feet of each other. In this part the current is very rapid, but from Warasdin the river flows sluggishly through a level country, forming swamps in many places. Gold-dust is found in this river. The lower part of its course is navigated by steamers.

DRAW'BACK is a term applied to repayments of duties (customs, excise, or stamps) previously charged on commodities, but from which they are relieved on exportation, that they may be disposed of in a foreign market on the same terms as if they had not been taxed at all. Were these duties not remitted the commodity so taxed would not be ordered from those foreign countries, where articles of the same kind could be purchased free of such duties. The only articles on which drawbacks are now payable are beer and spirits, gold and silver plate, tobacco manufactured in the United Kingdom, and roasted coffee shipped as stores. Adam Smith, in his "Wealth of Nations," discusses drawbacks, and sees in them nothing adverse to sound political economy under the given conditions.

DRAW'BRIDGE, a bridge used in ancient castles and in modern fortresses over a ditch or fosse, and capable of being raised up at one end so as to cut off the means of access. Drawbridges are usually formed of boards nailed to a frame constituting a platform, which is furnished at one end with hinges fastened to a beam placed parallel to one end of the frame. The bridge is raised by means of chains passed through the masonry of the gate, and these chains are worked either by wheels or by hand.

DRAWING, in its strict meaning, is the art of representing objects on a flat surface by lines describing their forms and contours alone, independently of colour or even shadow, although the latter is closely allied with drawing, both in practice and in theory. Alluring as colour is to the eye, and principal as it seems to be in painting, it is really subordinate to drawing, because, unless assisted by form, it is nearly valueless and unmeaning, and incapable of expressing anything; whereas form can distinctly represent objects without the aid of colouring or shadow. The latter is the adjunct and ally of the other two, being governed by both, inasmuch as form determines the position of shadows, and colouring their proper tone and hue.

In fact, the first step in an artist's career must be a long and arduous study of drawing, and nothing will dispense with the power to give a correct outline of any form occurring in his picture. Thus the landscape painter, though the least correct usually, yet must satisfy correctness to a large extent, and in any case must not commit sins against either botany or geology. Growing knowledge of nature indeed has already brought about a distinct advance in drawing among landscapists. The famous (and lovely) picture of Claude, one of the chief treasures of the National Gallery, could not be tolerated in one small point as a production of the present day, for the flags of half the ships are blown to the left and those of the other half to the right, and this without the slightest hurricane. In like manner the architect controls him who would draw houses, the sailor checks the marine painter, &c. In every department of drawing, in fact, a knowledge of the meaning and inner connection of forms is absolutely necessary. It would be almost impossible for one who had not been to sea, or undergone a very severe special training, to correctly draw the rigging of a large ship, even if he had the object before his eyes. But all these branches fail in the accuracy required of the animal painter and the figure painter, for here not special classes of the community, but every man is a competent judge. The exact likeness of the portrait-painter is only obtained by faultlessly accurate drawing.

The drawing of the human figure is the most scientific in itself and the most important in art. In order to attain to a complete mastery of the human figure, which after all is to be regarded only as the means to a higher aim, and the mechanical apparatus for effecting it, it is necessary to commence by studying what is tedious in itself, and seems almost foreign to the artist's purpose—namely, the internal configuration of the human frame. It is not enough to understand the proportions of the body and limbs, with the form and situation of the external muscles, but it is necessary that all the muscles, their purposes and functions, should be well understood; nor must osteology, or the bones of the skeleton, be neglected. Indeed it is desirable that the artist should be able to draw the skeleton figure in any attitude, by which his figures will always be well put together. Without scientific knowledge of muscular action, the painter will be able to give his figures only attitudes, and those not always correct, should he have occasion to represent such as from their nature do not admit of being copied from the life. Unless, besides possessing a complete knowledge of the human body, and the action of the limbs and muscles, he is also able to express the emotions of the mind, and that not as they display themselves in the countenance alone, but in gesture, attitude, and the whole frame, he will at the best produce only clever academical figures, skilfully drawn, but devoid of soul and sentiment. He must therefore endeavour to make himself master of expression, in the most comprehensive meaning of that very arduous and complex study, which, be it observed, depends entirely upon drawing and truth of delineation. For this purpose such works may be recommended as Sir Charles Bell's "Anatomy of Expression."

Perspective, which is treated of separately, and forms a distinct study, is nevertheless essentially a part of drawing —in fact, its very grammar. All objects are subject to its laws, although they do not admit in all cases of being delineated in perspective so accurately as such things as consist of strict geometrical forms. But besides the perspective of drawing there is the perspective of painting, or what is called *aerial* perspective. Both are treated of in the article PERSPECTIVE.

Drawing, as far as regards facility in delineating common forms and objects so as to enable a person to describe them promptly with the pencil, ought to be considered nearly as indispensable a part of education as writing itself. By this is meant such a degree of proficiency as would enable a person either to express or explain his ideas upon paper, or to sketch from nature.

There are various manipulations or modes of drawing, distinguished according to the materials or implements made use of, such as chalk, pencil, blacklead pencil, sepia or other tinted drawings. The last-mentioned class are sometimes called washed drawings, some indication of colouring being occasionally introduced. But what is termed water-colour "drawing," as now practised, is altogether a species of painting, although the process is altogether different from that of oil-colour painting or distemper. [See WATER-COLOUR, PAINTING, DISTEMPER]. Pen-and-ink drawings in the style of etchings, either with or without the addition of wash of shadow, are capable of producing considerable effect, as, for instance, the unrivalled architectural drawings of old Norman cathedrals by Prout, so highly and deservedly praised by Ruskin.

Painters' drawings or studies, such as those of the old masters, are highly valuable, because they often exhibit their first conceptions in all their energy, and admit us to immediate intercourse, as it were, with their ideas as they arose in their minds. Those of Turner in the crypt of the National Gallery are in this sense invaluable. All the principal studies in pencil or chalk of the great masters are now reproduced in AUTOTYPE, a photographic process which so exactly imitates the original, if skilfully done, that the copies are (except for a collector) as good as the originals.

Our Plates illustrate the principles insisted upon above, and indicate more clearly the manner in which "artistic anatomy," or the requisite knowledge of the underlying structures, is to be applied in animal and figure drawing. In Plate I. this is shown with the skulls of a cat, a pig, and a horse; the cause of the striking Roman nose so characteristic of the latter being well seen in its skull, for instance. A little examination will show that every feature of the skull influences the exterior aspect of the animal. In drawing a skull accurately it is well to arrange the perspective according to three imaginary planes, all at right angles with each other. The first is the plane of the "occipital line" (or the maxillary plane), cutting the extremity of the nose and passing through the "auditorial line" (or line joining the orifices of the ears) to the occiput or back of the skull. This plane should be made horizontal by supporting the skull as required. The other planes should be vertical; they are the "coronal plane," containing the auditorial line, and the "mesial plane," at right angles to it, dividing the face and skull into a right and left, and containing, therefore, the occipital line. It is better also, as in fig. 1 (which is the anatomical study for fig. 2), to arrange the skull so that the occipital line lies above and is parallel to the diagonal of a square drawing-board (that is as much as to say that the mesial plane will contain that diagonal). This hint is of much service in the perspective part of the work, since the vanishing point of the auditorial line will be then the centre of the vanishing line of the coronal plane, &c. Or the mesial plane may be parallel with the board, as in fig. 9, another easy position to arrange. In addition to these three planes the facial angle should be observed; that is, the angle which the facial line makes with the occipital plane, and which differs in every species of animal and in every race of man. Figs. 3, 4, and 5 show the downward, front, and side views of the cat's skull. Figs. 6, 7, and 8 give the head of a horse, and figs. 9 and 10 that of a pig. These planes and lines are shown as applied to the human skull in Plate II. Here the difficult positions of figs. 7 and 8 are brought into manageable compass by the consideration of the mesial and occipital planes shown in fig. 11 (where *m*, the occipital foramen, the entrance of the spinal cord, is seen to be almost in the centre of the skull beneath), and the mesial plane shown in the profile of fig. 10. The coronal plane would be seen edgewise in fig. 10, its edge being the line *x x*; it is not expressible in fig. 11 without confusing the rest. Fig. 9 gives a head with the shoulders in three positions, so that if the page be rotated a little, and the attention fixed on another pair of shoulders, the expression of the head will be found to alter greatly, although such an anatomical study of the skull as we have suggested would perfectly well serve, since the head remains the same in all the positions.

The line of heads (figs. 1 to 6) at the top of Plate II. is very interesting, and exceedingly useful to one who wishes some rough rules for getting the characteristic expressions of the varieties of the human face and head. First, the Negro (fig. 3) shows the *prognathous* facial angle, from 70° to 80°, which the line P G makes with the line A B (parallel to the coronal plane L Q, which is seen edgewise, E being its intersection with the maxillary or occipital plane); then the European child (fig. 4) shows an exaggerated *orthognathous* type. The orthognathism of the European becomes less pronounced as he grows up, but never altogether loses the inclination of the angle towards the face—*i.e.* opposite to that of the Negro. Figs. 1 and 2 show useful contours of the face in infancy and in youth, grouped into two circles, the relative size of which is clearly indicated. Figs. 5 and 6 also show the profile, where the skull is treated in the same way, the large circle giving the occiput. The upward motion of the chin and downward curve of the mouth in toothless age (fig. 6) are well contrasted with the full normal contours of youth (fig. 5) and the short mouth and chin of childhood (fig. 4). The brain-case is seen to vary little in all cases, though the size and character of the face alters the apparent size greatly until it is thus examined.

The expression of the face is the subject of Plate III., and here a knowledge of the anatomy of the underlying muscles is imperatively necessary to the artist. To show this, some muscles of the mouth, nose, and eyebrow have been selected; and it is surprising how many emotions can be indicated by so few muscles. No. 1, the *superbus*, pouts the chin; 2 draws down the nostril and the corner of the mouth (*depressor labii superioris alæque nasi*); 3 is the opposite to 2, and by itself is as sneering as that is gloomy in effect (*levator labii superioris*); 4 is the characteristic *compressor* of the nostrils; 5, the *depressor* of the lower lip, often unites with 2 in expression of grief; 6 is the special *depressor* of the corner of the mouth; 9, the *orbicular* muscle forming the mouth itself, and the two zygomatics; 10 is the *levator* or raiser of the parts depressed by 5; 11 is the antagonist of 6, being the levator of the corner of the mouth, as in smiling, or in laughing, when 11 and 3 combine. Finally, the upward action of the *frontalis* muscle is shown in 7, and the *corrugator* of the eyebrow in 8. The reader can easily trace for himself the action of these several muscles in the specimens of expressive faces which complete the Plate, as the important action of muscle No. 8 in "disdain," the strong effect of the corrugators in "hate," &c.

Movements of the arm and hand are, next to the face, the most characteristic modes of expression. The arm is attached to the shoulder-blade, a triangular bone well shown in figs. 5, 6, 7, and 8, Plate IV., and lying upon the back of the ribs. These four figures show the position of the bones in ordinary movements. The thorax, or bony case formed by the ribs, is best conceived as a truncated cone, or, more correctly, as a pyramidal figure (figs. 3, 4), the angles of which are nearly those given in the diagrams. The ribs fall very nearly within diverging lines, as in fig. 4. Fig. 1 shows the "plan" of fig. 3, the upper ring being that of the topmost rib, the lower and larger that of the widest ribs. In figs. 2 and 4 the collar-bones are shown joining the shoulder-blade to the breastbone. Fig. 9 indicates the best way of drawing the pelvis in true perspective by help of the imaginary lines and angles shown in the Plate. The motions of the hand are divided into *supination* (palm up) and *pronation* (palm down)—which

are truly motions of the wrist; motions of the hand proper are wrought by muscles on the side of the palm which curve the hand and fingers, and by muscles on the side of the back which extend them, &c. A special muscle has the function of "opposing" the thumb to any part of the hand, this freedom of the thumb being a characteristic feature of the order of primates only.

The chief points about the foot, fig. 10, in artistic anatomy are the position of the heel, A B, of the inner arch, A D, and the sub-arch, D C. The support of all the toes along the line D K gives a side of this last, and when a person stands on tiptoe the line D E is the hinge, so to speak, on which the foot turns. (It is, perhaps, worth while mentioning that tiptoe is the usual position of nearly all animals except man. See ARM, SHOULDER, LEG.)

The detailed study of drapery is too wide a subject for the present article; but an extended survey of folds will bring most of the finest of them under the three varieties of Flaxman indicated in Plate IV., fig. 11; that is, either a perpendicular series of folds, as when a cloak hangs from one point; or a diagonal series of folds, as when it is suspended from two points; to which may be added the cascade of diagonal forms when the edges fold diagonally with relation to the extremity. But upon these varieties countless variations may be made.

The movements of quadrupeds are so complex that they have never yet been satisfactorily ascertained—usually the body of a horse, for instance, is considered as covering a rectangle, like a box-shaped form supported on four posts, which moves forward, in a gentle walk or trot (figs. 9, 10, Plate V.), to a rectangle half the length of the first in front of it, the four feet marking the angular points. In galloping the rectangle changes by its whole length, and the front legs and hind legs mark the same points as the animal bounds forward in a series of springs (fig. 8). This is the usual theory of painters put in a rough way; but it is now admitted on all hands to be conventional, and some recent instantaneous photographs of a hunting-field show the real positions of the animal's legs and body to be altogether different from those agreed upon by general consent to stand for them.

The erect posture of the human body is the result of such a marvellous series of strains and counterstrains that it never ceases to cause admiration to anyone who studies it. But the erect posture, though so difficult to maintain that other vertebrates (fig. 7, Plate V.) never assume it of their own free will for more than a moment, and even monkeys sit down to handle anything with care, becomes far more difficult when progression is also to be gained. Man does not totter forward like a pair of compasses, of which each leg alternately becomes the pivot (figs. 5 and 6). The walker is seen to form an isosceles triangle with his legs, rapidly changing to a right-angled one as the right heel, rising from the ground, makes the right leg longer and thrusts forward the body, while the left leg becomes vertical. The body once in motion would fall forward if the right leg did not advance to check it by support from the front. The left heel is now raised and the process recommenced. The leg swings forward almost by gravity to take the new step, very little muscular action being required. The succession of joints and levers of the ankle, the knee, and the hips is shown in the diagram fig. 4, the upper rod standing for the body and arms altogether. By help of this diagram fig. 3 gains new interest. Observe that the centre of gravity is violently thrown forward to assist in the spring, but drops behind the heels in alighting, the arms being at the same time whirled back to aid the body in stopping its forward motion.

It may be well to close this article with some of the generally received "scales" of the human figure. That of Flaxman is exceedingly beautiful and easily intelligible from the engraving (Plate V., fig. 1); the other (fig. 2) is the ingenious "scale of 31 noses," which takes the nose for its unit, and measures everything by that. It will be found very fairly accurate on the average, and is of great assistance in checking the proportions of a figure, due allowance being made for perspective and foreshortening.

DRAYTON, MICHAEL, was born at Hartshill, in Warwickshire, in 1563. Little is known with certainty of his early life. It is supposed that he went to the University of Oxford, but without taking any degree, and also that he was in the army at an early period of life. His earliest work was published in 1593, under the title of the "Shepherd's Garland;" it was afterwards revised and reprinted in 1619 under the name of "Eclogues." Shortly after the "Shepherd's Garland" appeared his long historical poems, "The Barons' Wars," "England's Heroical Epistles," &c. His "Polyolbion," a descriptive poem on England and her natural productions and legends, made its appearance in 1613. In 1626 Drayton was poet-laureate. He died in 1631, and was buried in Westminster Abbey.

DREAMS are mental visions during sleep. Dream is an Old English word with the various meanings of "vision," "harmony," and "happiness"—whence the expression "a dream of bliss." Its modern meaning, except in poetry, is limited to that which heads this article. Etymologically the word is allied to *drum*, *drone;* whence both its meanings, at first so incongruous, easily arise. (√ DHRAN.) This mental state has much engaged the attention of psychologists. In the working of our highly complex spiritual nature, the will during sleep seems to have no control either over our thoughts or over *the order* in which they present themselves. When we do not dream, does the mind sleep as well as the body? When we dream is the body necessarily influenced by the soul, or have we mental visions which leave the body undisturbed? These and many other questions relating to dreams have engaged much attention of late years, and if an entirely satisfactory solution has not been reached, it may at any rate be said that the error of many popular ideas on the subject has been made very clear. People are not so wont as formerly to interpret dreams as omens or signs, and still more seldom are they now attributed to supernatural agencies, such as God, the devil, fairies, fiends, &c. Among the Persians dream interpretation, known as oneirocritics or oneiromancy, was an art defined and fixed in a number of rules. Still later the divine origin of dreams became a doctrine of the early Christian church. It appears in the writings of the fathers, being defended partly on biblical, partly on classic authority. Reduced to scientific inquiry, however, dreams are found to have so intimate a connection with certain conditions of the body and mind, that it is impossible to resist the conclusion that the brain, nerves, and stomach are much more responsible for our visions of the night than any supernatural agency.

It is not difficult to conceive how events happening *during* sleep can be responsible for our dream-experience. Sleep has under normal circumstances the effect of closing the sensory ganglia against the reception of external impressions. But dreams have been stimulated by acting upon the senses of the sleeper, as by whispering in his ear, tickling his lips, &c., in the experiments of Maury and others; and in this way the dreamer's train of thought has been so controlled that he has been made to act his dreams by speech or muscular movements, while all the time unconscious of such suggestions, and with no recollection of them on awaking. All this, however, is quite exceptional to the ordinary experience of dreaming, and has nearer relation to somnambulism. Like the latter it may be called sensori-motor dreaming, and becomes clear when we consider that sleep is probably due to a bloodless state of the brain: if then the great sensory ganglia at the base of the brain (the seats of consciousness) are aroused and receive a partial bloodflow, while the cerebrum still

remains asleep, then by the usual reflex action of a sensori-motor nature, the sleeper follows the dictates of his own senses, but not those of his mind or will, the latter being dormant. If, however, the cerebrum becomes partly awake the sensory impulses form part of the dream. The usual course is for the cerebrum to awake first, and hence the dream is a purely mental train of ideas (chiefly those of memory) in general. It may be that the cerebrum is partially awake while the rest of the body is lost in slumber. In fact, varieties of dreams depend on varieties of sleep. The absence of the controlling will accounts at once for the exaggeration and for the extravagance of dreams mentioned earlier in this article.

DREDGERS or **DREDGING MACHINES** are employed for clearing away matter from the beds of rivers, canals, harbours, and basins. Some machines for this purpose may be compared to harrows or shovels, which loosen the deposit, preparatory to its removal either by the action of the tide or by sluicing. But for the most part dredgers remove as well as loosen the deposit. Steam dredging has become of greatly increased importance of late years, from the part it has played in the cutting of great canals, like that of Suez, and the conversion of small streams, like the Clyde and the Tyne, into rivers navigable by the largest modern vessels. Dredgers may be divided into two classes—the barge-loading dredger, which confines its operations to the actual process of dredging, and leaves to other vessels the task of removing the material raised by it; and the hopper-dredger, which is itself a cargo-carrying steamer, fitted with special appliances for discharging the cargo at a suitable place into the sea. Our Plate illustrates the internal arrangements of one of the former, the reference to the various parts being given for convenience on the Plate itself. The most powerful dredger of this class is the *Clyde*, at work on the river Clyde, constructed by the well-known firm Messrs. W. Simons & Co., Renfrew, in 1882.

Its dimensions are:—Length, 160 feet; breadth, 30 feet; depth, 10 feet; length of bucket ladder, 90 feet. The *Clyde* is capable of dredging to a depth of 35 feet, and of raising 500 tons of free soil per hour. There are thirty-nine buckets, each holding 15 cubic feet of soil. The ladder, with its tumblers, buckets, rollers, &c., weighs about 100 tons, and by its powerful hoist gear is perfectly under control. The main engines are on the compound system, of 400 horse-power, and drive patent friction wheels, which were found to act efficiently in preventing accidents when dredging the extremely hard boulder clay in the channel at Port-Glasgow. The dredger's crew consists of thirteen men, and in each steam-hopper barge there are seven men.

By the hopper-dredger system, which is now coming into general use, tug-steamers for stationary dredgers and barges are dispensed with, as one vessel with one crew is adapted to do the work of all. The new steam hopper-dredger *Forth*, constructed by Messrs. Simons & Co. for the Caledonian Railway Company, may be described as a type of this class. It is the fifteenth hopper-dredger built by that firm.

Its dimensions are:—Length, 170 feet; breadth, 36 feet; depth, 14½ feet. Its appearance and model are very like a screw steamer of that size. Its internal arrangements, beginning at the bow, are—first, the steam winches and capstans, having head and thwartship motions for mooring and dredging; next are four connected box-iron shear legs, on the top of which are the large iron purchase pulleys, to receive the elevating chain of the bucket girder, the lower end of which chain descends through the iron deck to the massive spiral disconnecting chain barrel (placed under the deck and driven by steam). Proceeding aft along the deck we come to the midship box-iron framework, standing a considerable height above deck, and formed of strong iron truss work, secured to the keelson and deck; on the upper part of this is hinged, on steel and brass, the bucket girder, 80 feet long, with its chain of steel mounted buckets representing a gross weight of 100 tons when at work. This framework is further connected to the hull, fore and aft, by long iron diagonal girders, on the top of which is placed the steel wheel gearing and shafting for working the dredging buckets and chain. The buckets are constructed on a recent improvement of the builders, which supersedes the expensive repairs necessary on the ordinary buckets; and there is provided between the buckets a range of steel grapnels or claws, by which the hard limestone channel, where the vessel is to work will be torn and broken up, and the *debris* raised in the following buckets. Proceeding a short distance still further aft we come to the hopper cavity of the cubic capacity of 1000 tons. In its bottom are a range of hinged doors, supported vertically by strong tested bridle chains to four thwartship box-iron hopper beams, through which they pass over iron pulleys to the respective crab-winch purchase of each hopper door. These crabs are ranged along the strong fore-and-aft iron cooming of both sides of the hopper mouth. The hopper cavity is filled in two hours. On each side here, reaching down from the upper dredge tumbler block, but placed on either side, are the ordinary shoots reaching over the gunwale, so that the vessel, besides her special properties, can, if required, load barges alongside as well as herself. Proceeding still further aft we come to the bridge, on which the vessel is steered and navigated; then to the boiler compartment, in which are secured, side by side, two of the most improved tubular boilers, fitted with two funnels, placed opposite each other thwartship; on each side are iron coal bunkers for a suitable supply of coals, and communicating with the stokehold. On deck here are lifting davits and position for the lifeboat, anchor boat, and service boat. Further aft again is the engine-room, in which are erected two sets of surface-condensing compound engines, each coupled to its separate independent twin screw propeller, collectively of 500 effective horse-power. In connection with these engines are governors and other necessary regulating gearing; also the disconnecting appliances, which at once *convert the hopper-dredger into a screw steamer*, and *vice versâ*. Further aft is the after water-tight stern compartment, securing the safety of the vessel from any accident to the twin screws. The vessel is fitted besides with other five water-tight bulkheads and a complete iron deck, with comfortable accommodation for the officers, engineers, and crew, and with kitchen, workshop, and ample store-rooms.

DREN'THE, a province in the kingdom of Holland, is bounded N. by Groningen, E. by Hanover, S. by Overyssel, and W. by Friesland. It lies between 52° 35′ and 53° 12′ N. lat., and between 6° 5′ and 7° 5′ E. lon.; its length from north to south is 50 miles, from east to west also 50 miles, but the area is not in proportion to these measures, being only 1019 square miles. The population in 1880 was 118,845. Agriculture, pasturage, and digging and exporting peat form the chief employment of the inhabitants. The province lies on each slope of the watershed between the Zuyder Zee and Dollart's Bay. Several small streams rise in it; the most important of them is the Haventer-Aa, along part of which the canal from Meppel to Assen runs. Assen is the capital of the district.

DRES'DEN, the capital of the kingdom of Saxony, is situated on both sides of the Elbe, 116 miles south-east of Berlin. The fine plain in which it stands is bounded by many beautiful ranges of hills, and it is approached on all sides by fine avenues of trees. The city is divided into three parts—the Altstadt, the Neustadt, and Friedrichsstadt—in addition to which there are several suburbs. In recent years numerous improvements have been carried out in the city. The population in 1880 was 220,818.

Dresden contains eleven gates or entrances. There are numerous churches and chapels, of which the majority are Lutheran. In the Altstadt (the Old Town), the most interesting structure is the royal palace; it is an irregular building in the Gothic style, with a church which has the highest tower and steeple in the town. The celebrated Grüne-Gewölbe (green vaults) open upon the palace yard, and contain a costly collection of precious stones, including the largest onyx in existence, pearls, and works of art in gold, silver, amber, and ivory, which have been gradually accumulated by successive monarchs. The jewelry includes the Polish regalia. Close to the palace are the chancery building, the depository for the national archives, and the Stallgebäude (mews). Near this building stands the Zwinger Palace, in which are a handsome chapel, a gallery of portraits, a porcelain cabinet, a library of 10,000 volumes, and cabinet of engravings. Its style recalls the sumptuousness of Roman palaces and baths. The square adjoining it is called the Zwinger; three sides of it are occupied by six pavilions connected by a gallery, and the fourth by the museum, to which the picture gallery has been removed. This is one of the finest in Europe, and ranks with the Louvre, the Pitti, and the Uffizi. The pavilions contain a cabinet of engravings, a collection of mathematical and philosophical instruments, a collection of works of art in ivory, alabaster, silver, iron, wood, &c., a chamber of models useful in hydrography, mining, military architecture, &c., and a miscellaneous cabinet. The other buildings of note in the Old Town are—the Brühl Palace, containing a choice collection of Meissen porcelain; the academy of arts, school of design and gallery of duplicates, the mint, the arsenal, the medical and surgical school, the town hall, the trades' hall, the botanical garden, the post office, the treasury, the observatory, the mews and riding school, the military hospital, the orphan asylum, and several churches. The Court Theatre is one of the finest theatres in Europe.

Three suburbs are connected with the Old Town—the Pirna, See, and Wildsruf suburbs. Near the Pirna suburb is the Great Garden, which is nearly 5 miles in circuit, and to the right lies the nursery of fruit-trees, which contains upwards of 65,000 plants. From the Wildsruf suburb an avenue called the Ostra-Allee extends to a massive bridge across the Weiseritz, which leads to the Friedrichs-stadt, between which and the Elbe are the wooded grounds called the Ostra-Gehege.

The access from the Old Town to the New Town is by means of three stone bridges, one of which has sixteen arches, and is 1420 feet long. It opens upon a square planted with linden-trees; from this extends a broad street. lined with linden-trees. Here is situated the Japanese Palace or Augusteum, which is the depository of four choice collections—the cabinet of antiquities, the cabinet of coins, the cabinet of porcelain, and the royal public library, containing 300,000 volumes. Besides this large palace, the new town contains barracks, a town-hall, the cadet academy and engineers' school, a house of industry, baths, a theatre, a cemetery, a handsome English church, &c.

Dresden contains a high school and a large number of other educational establishments. There are a variety of learned and other societies, the chief of which are the Academy of Arts, the Society of Economy, the Mineralogical, the Natural History and Medical, the Bible, the Missionary, and the Saxon Antiquities societies. It has no external trade or manufactures of much importance. It is a place of transit for colonial and other foreign produce from Magdeburg, Hamburg, &c., and has six general fairs. Its mechanics, who are incorporated into sixty fraternities, have obtained some note in Germany for the manufacture of mathematical, mechanical, and musical instruments, engraving on steel and stone, the making of gloves, carpets, turnery ware, jewelry, straw hats, and porcelain.

Dresden is a city of Slavonic origin, first mentioned in history in 1206. It has been the residence of the sovereigns since 1485. During the reign of Augustus the Strong, from 1694 to 1733, it began to occupy a leading position as a cradle of art, and became famous for its porcelain produced by a process invented by Böttger, a chemist, in 1707. It, however, soon lost its reputation and sank into obscurity, and it was not until the middle of the present century, on its becoming the headquarters of the "Romanticists," that it again came into notice in art circles. Dresden has often suffered severely from the attacks of enemies. The last great battle fought under its walls took place on the 26th and 27th August, 1813, when Napoleon defeated the allies.

DREUX, an ancient town in the department of Eure-et-Loir, in France, stands on the Blaise, 41 miles west from Paris, and had a population in 1881 of 8000. It is partly surrounded by the Blaise, which here divides into several branches, and enters the Eure near the town.

Dreux stands in a pleasant country, and is pretty well built. Near the town stands the magnificent chapel built by Louis Philippe while Duke of Orleans, and greatly enlarged and beautified by him; hither were transferred in 1876 the remains of the late king, his queen, Marie Amélie, and of the other members of his family who, during their exile, were buried in English soil. The inhabitants manufacture serges, hosiery, and other woollen goods; they also trade in sheep and cattle. Near it, in 1562, the celebrated combat was fought in which the Prince of Condé, then at the head of the Protestants, was taken prisoner. It was captured in November, 1870, by the Duke of Mecklenburg in his operations against the "army of Brittany."

DRIF'FIELD, GREAT, a market-town of England, in the East Riding of the county of York, situated near one of the sources of the Hull, 193 miles from London, on the North-eastern Railway. A navigable canal connects the town with the port of Hull, and it has important corn and cattle markets. It has a fine old parish church and several places of worship for dissenters, a mechanics' institute, and a dispensary. The chief manufactures are carpets and chemical manures. Population, 5937.

DRIFT, a term which is sometimes used to denote the layer of broken soil which in most places covers the rock that is uppermost, and which is, as a general rule, derived from the disintegration of that rock. Thus a shale or slate will be covered to a certain depth by clay, a sandstone by loam, and a limestone by loam or marl—the result of their respective weathering and disintegration. The use of the term is now becoming restricted to the drift of the glacial epoch—the so-called *till* or *boulder clay*. The general character of this deposit is a stiff clay containing more or less rounded fragments of stone imbedded in it, the clay being the finer particles resulting from the grinding and erosive action of the GLACIERS, while the imbedded stones, sometimes large boulders, are broken masses of rock carried down with them. These stones are for the most part derived from the rocks of the district in which the drift occurs, but among them are fragments which have evidently come from a distance, sometimes from a very considerable distance. Fragments are found in the drift of the Forth valley which have been broken off from rocks in the Highlands 50 miles away; pieces of syenite from Laurwig, in Norway, have been found in the drift of Holderness and near Hamburg; fragments of rock which certainly came from Gothland are found in the drift of Holland; the Norfolk drift contains broken pieces of rock from the Scandinavian mountains. Fossils washed out of older formations are sometimes carried into the drift; thus Lias fossils may be found in one or two places near the north of London. The boulders in the drift are often polished and striated. The thickness of the drift is very

variable. It occurs in patches all over the lower part of Europe and North America, bearing testimony to the wide extent of land which was ice-covered. Much of it has no doubt been completely removed by denudation. See PLEISTOCENE.

DRILL, in a military sense, is the training of officers and men in the various exercises necessary for efficiency in active service. Many of the simpler exercises are common to the whole army and navy, but each department, as infantry, cavalry, and artillery, has a large amount of drill peculiar to itself. Other variations are to be found in the numbers engaged, as, for instance, in squad drill, company drill, battalion drill, &c., and in the weapons used, as in the small-arms exercises and the manipulation of field, siege, or garrison guns. A course of drill sufficient to properly train a cavalry soldier or an artilleryman extends over a considerable period, and at least four or five months of steady application are necessary for the simpler duties of the infantry.

In former times the chief attention in drill was given to movements in close formation, and qualities of steadiness and accuracy were chiefly aimed at; but the changes wrought in modern warfare by the introduction of arms of precision, having a rapid fire and a long range, have greatly extended the scope of military drill. Much now depends upon the power of non-commissioned officers and men to take the initiative without word of command, so that every advantage offered by the ground in the way of cover may be utilized either for attack or defence, and drill must be extended over a wide and varied range of country in order to be effective. The improved modern weapons placed in the hands of soldiers also require a considerable amount of skill for their effective use, a circumstance that for some time scarcely received sufficient attention in the British army. The unhappy experiences in the Transvaal in 1882 were not without effect, and this important department of drill is now most thoroughly taught.

DRILL (*Cynocephalus leucophœus*) is a species of BABOON, native of Guinea, and when adult approaches the largest of its kind, the MANDRILL, in size, agreeing with it also in habits and disposition. Adults are rare in our menageries, but young specimens are not uncommon; these, however, seldom survive the complete acquisition of the permanent teeth. In this species the head is large; the muzzle is thick, with elevated maxillary protuberances, which are not furrowed; the face and ears are glossy black; the tail is short and carried erect; the general colour is greenish-olive above, gray beneath; the beard is short and orange-coloured; the callosities are scarlet. The female is smaller, with a shorter muzzle and a paler tint of general covering. It would appear that the wood baboon, the cinereous baboon, and the yellow baboon of Pennant are the young of the drill at different stages of growth.

DRILLING. See AGRICULTURE.

DRIPPING, the fat which falls from roasting meat, is probably the most nutritious of all food-fats. [See FAT.] It contains scarcely any water, has all the fine aroma of the meat, and can be eaten in the same way as butter. Indeed, camel-dripping is the great luxury of the Bedouins. Properly collected roast dripping contains 5820 grains of carbon in the pound, butter containing only 4760 grains. If also the free hydrogen be reckoned with the carbon, the quantity rises to the considerable amount of 7511 grains per pound.

DRIVING, LAWS AS TO. A person driving along the highway is not bound to keep on any particular side when the road is clear; but if he drive on what is known as the "off" side, *i.e.* the right-hand side, he must keep a good lookout and get out of the way of those vehicles which are on their proper side of the road. Furious driving is an offence against the statute law, and any person riding any horse or beast, or driving any sort of carriage, so as to endanger the life or limb of any passenger is liable, on conviction, to a penalty of £10 if the owner, or of £5 if only the driver of the carriage. Should any person be actually injured the driver is guilty of a misdemeanour punishable by two years' imprisonment. In the case of cabs, omnibuses, or any stage carriages and horses let for hire, a person injured by the recklessness or drunkenness of the driver can bring an action for damages against the *proprietor* of the vehicle. No stage coach can lawfully carry more passengers than it is constructed and licensed for, and the statute requires that a space of 16 inches be allotted to each passenger. Bicycles, tricycles, sociables, &c., are "carriages," and their propulsion by a person or persons seated therein constitutes the "driving of a carriage," within the meaning of the Highway Acts.

DROGH'EDA, a town, municipal and parliamentary borough, port, and, with the surrounding district, also a county, in the province of Leinster, in Ireland, is situated between the counties of Louth and Meath, on both sides of the Boyne, 4 miles from the sea, and 29 north from Dublin.

The modern part of the town is tolerably well built, but contains no fine streets and few public buildings worthy of notice as works of architecture. The streets and lanes in many of the older parts are very narrow and in some parts dirty. The supply of water to the town was formerly insufficient and defective, but by the construction of new works 800,000 gallons of the purest water are obtained daily. Half the cost was contributed by Mr. B. Whitworth, M.P. The town contains a mansion-house, hotels, town-hall, linen-hall, custom-house, union workhouse, barracks, three churches, two Roman Catholic chapels, one of which is considered the cathedral of the archbishopric of Armagh, three friaries, four nunneries, a Presbyterian chapel, and a Methodist chapel. Among the ancient buildings are the ruins of St. Mary's Church, a Dominican abbey, and St. Laurence's Gate, a fragment of the walls which formerly surrounded the town. Assizes, quarter-sessions, and petty sessions are held in the town. There are iron-foundries, cotton and flax spinning mills, corn mills, salt-works, tanneries, soap-works, and breweries. Drogheda carries on a considerable trade, chiefly with Liverpool and Glasgow. The exports are principally corn, meal, flour, cattle, provisions, and linen. The harbour, formed by the waters of the Boyne, 4 miles from the sea, extends about half a mile below the bridge, with from 16 to 18 feet of water abreast the quays, at which vessels of 400 tons can moor; the tide flows up as far as Oldbridge, 2½ miles above the town, whence the Boyne navigation for barges of 50 tons extends inland to Navan, 19 miles. The port and harbour are under commissioners, constituted by Act of 5 Vict., by whom the port has been considerably improved, and its revenue within the last few years more than doubled. There are a small shipbuilding yard and a patent slip. At the entrance of the harbour are three lighthouses, distinguished as north, east, and west, two of which are movable, according to the changes in the bar. The number of vessels registered at the port in 1887 was 35 (4800 tons). The entries and clearances average 650 (140,000 tons per annum). The town has a station on the Dublin and Drogheda Railway, and an extension of the line is open to Enniskillen. There is also a branch line to Navan and Kells, and the Belfast Junction Railway runs to Newry and Armagh. The municipal borough is divided into three wards, and is governed by six aldermen, of whom one is mayor, and eighteen councillors. The parliamentary borough returns one member to the House of Commons. The population in 1881 was 14,662, and the number of voters is 670.

Drogheda, formerly called *Tredagh*, has been a place of note for its ecclesiastical establishments from an early period, and its political history has been of interest since

1220, when Henry III. retained it in his own possession out of a renewed grant to Walter de Lacy, down to the battle of the Boyne, which took place in 1690, about 2½ miles above the town, Drogheda itself surrendering to the conqueror. It has been the scene of several parliaments, one of which, in 1495, enacted the famous Poyning's Act. Cromwell took the town by storm, and put the governor, Sir A. Ashton, and the whole of the garrison to the sword, 12th September, 1649.

Droghéda had some centuries ago the right conferred on it of establishing a university, but the privilege having remained in abeyance, an attempt to exercise it in modern times was not successful.

DROITS OF ADMIRALTY. Derelict ships and other property picked up at sea by British vessels, if not claimed, are deemed droits of admiralty, and were formerly the perquisites of the lord high admiral of England, an office at one time held by King William IV. when duke of Clarence, but it was subsequently abolished. The collection of these droits formed part of the duties of the late receiver-general, but by the Merchant Shipping Act, 1854, it was placed under the control of the Board of Trade, by whom all the proceeds are now paid into the public exchequer. Seizures of property belonging to the enemy on the breaking out of hostilities are likewise deemed droits of admiralty.

DROIT'WICH, a market-town and municipal and ex-parliamentary borough of England, in the county and 7 miles from the city of Worcester, 116 miles N.W. of London by road, or 126 by the Midland Railway, is pleasantly situated on the Salwarp, in a narrow valley. Its chief trade is derived from its salt springs, rising through strata of red sandstone and gypsum, from which salt has been made from time immemorial (the town was the Roman *Salinæ*, on the Salt Way, which united Worcester and Birmingham); but the quantity has been largely increased since 1725 by sinking the pits, which are in the centre of the town, to a greater depth, where the brine was found to be much salter, and from which it rose, as before, to the surface. It is first pumped into reservoirs, then passed into iron boiling pans, and the deposit afterwards dried in storehouses. The liquid yields 33 per cent. of salt, the quality of which is universally admitted to be among the very best in the world. A large quantity is exported to foreign countries. The town is built in a rather irregular and straggling manner. There are several churches, three or four chapels, a court-house over the market, Coventry's hospital and schools, endowed with over £1200 a year, and a lunatic asylum. It is the head of a county court. The municipal borough is governed by four aldermen, including the mayor, and twelve councillors. The parliamentary borough was among the number which were disfranchised by the Redistribution Act of 1885. The town is named from *wiches* (Saxon for salt-springs), the prefix *droit*, right or legal, being supposed to refer to some exclusive privilege for the manufacture of salt granted to the inhabitants. Tesselated pavement and other antique Roman remains have been discovered here.

DROME, a department in the south-east of France, formed out of a portion of Bas Dauphiné, is bounded N. and N.E. by the department of Isère, E. by that of Hautes Alpes, S. by those of Basses Alpes and Vaucluse, and W. by that of Ardèche. Its greatest length from north to south is about 80 miles, from east to west 50 miles. The area is 2518 square miles, and the population in 1886 was 314,615.

The department forms an inclined plane which slopes from east to west. About one-third of the surface consists of a sandy plain running north and south along the Rhône, with a breadth of from 5 to 8 miles. The rest of the department is mountainous. From a secondary chain of the Alps, which runs along the eastern boundray, numerous offshoots extend westward, gradually diminishing in height as they advance in that direction, and finally subsiding into the valley of the Rhône. The highest of these masses is more than 5000 feet above the sea, but the general elevation of the ridges is not much above 3000 feet. Their summits, which are everywhere accessible, yield good pasturage in the summer and autumn, and at these seasons they are frequented by migratory flocks of the neighbouring departments; their sides are covered with dense forests of pine, oak, beech, cochineal-oak, &c. The valleys between these mountain ridges, which are the chief haunts of the population, communicate with each other by narrow dangerous by-roads, and are furrowed by rivers or mountain torrents that frequently cause great losses by their overflow. The facilities for irrigation are very great, and this aid to culture is extensively adopted, especially in the valley of the Rhône, the fertility of which is in a great measure owing to the skilful employment of the system of irrigation. The air is pure and healthy. The high mountains are covered with snow during several months of the year, but in the valleys and along the Rhône the heat in summer is intense. North and south winds alternately prevail, the former bringing dry weather, the latter rain.

The Rhône, which divides this department from that of Ardèche, is navigated by steamers, and receives all the rivers of the department, which are here briefly described, proceeding from north to south:—The Galaure, which rises in the department of Isère, crosses the north of the department, and enters the Rhône at St. Vallier. The Isère, remarkable for its deep, black waters, and the magnificent views which its valley presents, receives in this department the Herbasse, and joins the Rhône a few miles N. of Valence; it is navigable. [See ISÈRE.] The Veoure has its whole length in the department, and flows S.W. into the Rhône past Chabeuil. The Drôme, which gives name to the department, rises on the confines of Hautes Alpes, and flows in a rapid stream N.W. as far as Die, receiving the Bes on the right bank; from Die to Pontaix its course is nearly due W., and from the last-mentioned town it runs S. to its junction with the Rohanne on the left bank, whence it flows W. to the Rhône, which it enters below Livron after a course of 66 miles. A good deal of loose timber is floated down this river as far as Pontaix, above which its bed is very rocky; here the timber is made into rafts and floated on to the Rhône. No part of the Drôme is navigable. The next river to the south is the Roubion, which is joined by the Jabron at Montélimart, just before its entrance into the Rhône. The Lez forms part of the southern boundary, and flowing S.W. enters the Rhône in the department of Vaucluse. The Eygues rises in the south-east of the department, and passes Nyons, below which it enters Vaucluse, and joins the Rhône a little W. of Orange. The Ouvèze rises in the extreme south of the department, and passing Le Buis, enters Vaucluse on its way to join the Sorgues.

Corn sufficient for the consumption is not produced; maize, buckwheat, and haricot beans are the chief crops. The olive, the walnut, the almond, the chestnut, and other fruit trees, are cultivated with success. The mulberry tree is extensively grown for the production of silk; the first crop of leaves serves to rear the silkworms, and the second is given to cattle. The number of mulberry trees in the department is very large, and the quantity of raw silk produced has been increasing for many years past. The culture of the vine is an object of great attention in the valley of the Rhône, and in the arrondissements of Die and Nyons. The annual produce of wine is 9,000,000 gallons, a large portion of which is exported; the best kinds are the famous red and white wines called Hermitage, which for their mellifluous goût, colour, and perfume, rank among the best wines in the world. Black truffles of excellent quality are abundant. Horses and horned cattle

are not numerous; mules are the common beasts of burden. Sheep and pigs are reared in considerable numbers. Among the wild animals are foxes, wolves, deer, chamois, beavers in the islands of the Rhône, otters, hares, rabbits, eagles, vultures, pheasants, partridges, &c. There is a good deal of meadow land, chiefly in the valley of the Rhône, which, by canals of irrigation, is made to yield two and three crops a year.

Several iron mines are worked; copper and lead are found; coal is met with in various districts, but only one mine is worked. Sand used in glass manufacture, chalk, plaster-of-Paris, rock crystal, alabaster, granite, potter's clay, &c., are found. There are also several mineral and salt springs. The manufacturing industry of the department is important and active. Woollen cloth, silk, hosiery, serge, cotton yarn, leather, paper, nut and olive oil, brandy, ropes, lime, tiles, bricks, &c., are manufactured; there are various dyeing and bleaching establishments. Facilities are afforded by five governmental and twelve departmental roads; and the railway from Paris to Marseilles and Lyons, with branches, passes through the department.

The department is divided into four arrondissements—viz., Valence, Montélimart, Die, and Nyons. The capital is Valence.

DROM'EDARY is a name often, though wrongly, applied to the Arabian camel. The name should properly be restricted to a swift variety of this species, standing in the same relation to it as a race-horse or hunter to an ordinary horse (Greek stem *dromad-*, fast-running). See CAMEL.

DROMORE, a town of Ireland, in the county of Down, situated on the river Lagan, 16 miles S.W. of Belfast. It was formerly a bishop's see in the ecclesiastical province of Armagh, but was afterwards incorporated with the sees of Down and Connor, thus forming the bishopric of Down, Connor, and Dromore. Jeremy Taylor was bishop of the diocese, and he is buried in the parish church, which was built by himself. In a peat bog near the town the remains of a magnificent elk were found.

DRONE. The male bee is called a "drone" from its droning; the drone does not take its name from the bee. It is a far older word, coming indeed from one of those mysterious ARYAN ROOTS which lie at the basis of nearly all civilized speech. The root √DHRAN, to drone, to hum (plainly imitative of the sound), is in Sanskrit *dhran*, in Greek *thren-os*, a monotonous dirge. A closely allied word in the English and its ancestors is *thrum;* and *drum* and *dream* are also from the same root.

For drone as the male or non-working bee see BEE. As the male bee collects no honey he is assumed to be the type of idleness; whence, figuratively, idle men are called drones.

The *drone of a ballad* was a favourite device in early English minstrelsy. It was the repetition of a burden or continual phrase to fill up the pauses between verses or stanzas. Thus in the "Tempest" Ariel sings, in "Come unto these yellow sands"—

> "Foot it featly here and there,
> And, sweet sprites, the burden bear."

Whereupon is sung the drone or burden, with no very close relation to the stanza it follows:—

> "Hark! hark! Bow wow!
> The watch-dogs bark! Bow wow!"

The clown's song in "Twelfth Night," with its alternate drone of "With hey, ho, the wind and the rain," "For the rain it raineth every day," is one of the most charming:—

> "When that I was and a little tiny boy
> (With hey, ho, the wind and the rain),
> A foolish thing was but a toy
> (For the rain it raineth every day)," &c.

The *drone of the bagpipe* is the early attempt at supporting a melody by a constant accompaniment. There are several pipes supplied with wind from the "bag," but of these only one, the chanter, is truly an instrument of melody, governed by the fingers like a flute or a clarionet [see BAGPIPE], and the rest, two or three as the case may be, never vary their sound. The pipes are generally in D; and the drone would be D for the greater and A for the lesser fixed pipe, with an upper D if the drone is of three pipes.

Drone-bass, in musical composition, is a favourite device with the French at the present day. It consists in a musical variety of the ballad-drone, that is, in the constant repetition of a particular chord or arpeggio, no matter how the melody changes. It is in simpler cases almost a transcript of a bagpipe effect, and in this shape has been for centuries the musical conventionality for "pastoral" scenes; as in the following from the "Messiah," where it occurs as a tonic pedal:—

The reader will of course also think of the splendid opening of the Pastoral Symphony of Beethoven, the finest example of the kind ever written.

But a still higher form of drone-bass is that of a fixed succession of chords; and of this the most remarkable and beautiful example is the famous Berceuse (slumber-song) of Chopin, a pianoforte piece of the most exquisite embroidery ("musical lace-work," it has been fitly called), woven against the following drone-bass, which never alters for sixty-four bars. Eight bars of tonic harmony close the piece. We give the subject simply, omitting two bars of drone-bass which introduce it:—

DRONE-FLY (*Eristalis tenax*), a species of DIPTERA of the family SYRPHIDÆ, presents a very remarkable resemblance, both in size and form, to the common hive-bee. The drone-flies are common in gardens, where they may be seen in autumn clustering on flowers, and making a loud but musical hum. The larvæ are aquatic in their habits, and provided with a long telescope-like tail composed of two segments: this tail is elevated to the surface of the water, and through it the larva carries on respiration. The skin is remarkably tough. When the change into the pupal condition is imminent the larva quits the water and buries itself in the ground. The pupal condition is assumed within the larva skin, to which the tail persists.

DRON'FIELD, a small town of England, in the county of Derby, on the road between Chesterfield and Sheffield, 5½ miles N. by W. from Chesterfield and 151 from London by the Midland Railway. The parish church is beautifully situated on a hill on one side of the town. It has a fine tower and spire, chiefly in the Decorated English style. There are some manufactures carried on at Dronfield, chiefly of iron goods, as cast-iron chains and nails, axes, chisels, and other edge tools, common cutlery, and agricultural implements. The ruins still exist of Beauchief Abbey, founded in 1163 by Fitz-Ranulph, one of the murderers of Thomas A'Becket, in expiation of his crime.

DRONGO SHRIKES (Dicruridæ), a small family of Passerine birds belonging to the section DENTIROSTRES, and peculiar to Southern Asia and Australia. The drongos show strong affinities to the FLY-CATCHERS (Muscicapidæ) in the form of the beak, in the presence of bristles entirely hiding the nostrils, and in the short tarsi and toes, as well as in their general habits. The wings are very long and pointed. The species are not very numerous. Of the typical genus Dicrurus the commonest species, *Dicrurus macrocercus*, abundant in India, has received the name of KING-CROW. Another Indian species, the Paradise Drongo (*Dicrurus paradiseus*), is of a blue-black colour, with the head crested, and the two outer feathers of the tail much elongated, forming two long naked stalks, terminated by small palettes formed of barbs. This beautiful bird is abundant in the lofty jungles of Western India, where it is generally seen in small parties, often pursuing crows and birds of prey, and chasing them from its haunts. Its food consists principally of large beetles, which it usually catches on the wing; it also snaps up flying insects in the air, or snatches them from a branch. The note of this species is very peculiar, consisting of two parts, the first a sort of harsh chucklé, and the second a singular metallic sound, something like the creaking of a heavy wheel. It has other notes, and is said by the Hindus to imitate the notes of all other birds, whence it has been called by them the *huzar dustan* or "bird of a thousand tales."

The genus Artamus is represented in India by *Artamus fuscus*, and in Australia by *Artamus sordidus*, both catching their prey on the wing, and being social in their habits.

DRON'THEIM or **THRONDHJEM** (called by the inhabitants *Tron'yem*) is the most northern of the old provinces of Norway, extending from 62° to 71° 10′ N. lat. It lies between 5° and 31° E. lon., and its total area has been officially estimated at 58,423 square miles.

Drontheim comprehends the countries situated on the northern declivity of the Norrska Fiellen, and those which lie on the western and steeper slope of the Kiölen Mountains; the greater part of it is exceedingly mountainous, and very little is adapted for agricultural purposes. This circumstance, united to the severity of the climate, is the cause of its very small population, which is only 225,000, or less than four to the square mile. Drontheim is now divided into four provinces, North Drontheim, South Drontheim, Nordland, and Finmark.

North and South Drontheim are indented by numerous inlets, of which Drontheim Fiord is the most important, being 60 miles long by from 3 to 5 wide. South of it the country lies on the northern declivity of the Lang Field and Dovre Field, which are portions of the Norrska Fiellen. The coast is here very deeply indented by arms of the sea, which form numerous islands and peninsulas. Many of the fiords extend inland 50 miles, and on their banks are the only fertile spots. The interior of the country is occupied by the mountain region of the Norrska Fiellen, which rises in one point to a height of 7489 feet; it stands upon a table-land, which is furrowed by several steep ravines. The country along the southern shores of Drontheim Fiord contains a much greater portion of arable land, and is more extensively cultivated and more populous than the northern. It is watered by four rivers, which, from west to east, are called Oerkel, Gnul, Nid, and Stor Elf. The small district of Röraas lies on the Dovre Field, close to the boundary of Sweden, and comprehends the country in which the Glommen Elf originates. Northward of Drontheim Fiord an immense mass of high rocks extends along the sea from the shores of the fiords to the mouth of Namsen Elf, which is the largest of the rivers of Norway falling into the North Sea.

Nordland comprehends all the countries lying between the parallel of the Island of Leköe and the Quaenanger Fiord. The southern part is called Helgeland, the central district Salten, and the northern portion Tromsöe. The islands of Lofoden and of Senyen are also included in it. Helgeland has numerous islands near the shore, but the fiords are not deep. The interior is filled up by mountains rising from 1000 to 1500 feet, between which occur numerous narrow valleys and depressions, which in general are well wooded, though the trees rarely attain the size of timber trees. Salten comprehends the country between Cape Kunnen and Ofoden Fiord; it is the most desolate part of Norway, and the coast is marked by exceedingly precipitous promontories. The district of Tromsöe is on the mainland, somewhat beyond the parallel of the Lofoden Islands; it is a mountainous region.

Finmark comprehends the most northern portion of Drontheim, and indeed of the continent of Europe, extending from Quaenanger Fiord to the Tana-Elf and Varanger Fiord. Along its western side, between the Quaenanger Fiord and the Alten Fiord, extends a mountain range, which terminates near the sea in the isolated Yekuls Field, rising to 3700 feet, the most northern glacier (70° N. lat.) The country east of this range contains a more elevated and a lower region, of which the former lies to the north and the latter to the south. The permanent settlements in this district are only found in the recesses of the fiords. The lower region is in general a plain, which in its highest point, near the sources of the Alten Elf, is about 1200 feet high, and contains numerous small lakes. The snow-line in this province is less than 3000 feet above the level of the sea, and the mountains in the interior are thus perpetually covered. Agriculture is almost impracticable, and fish and game constitute the principal food of the inhabitants. No trees are found in the higher latitudes, but the turf marshes afford a good supply of fuel. The reindeer is the chief source of wealth in the north, and the cod-fisheries in the south. The population consists principally of Lapps. Several large islands lie along the coast of Finmark, west of the Porsanger Fiord. The largest of them, Seyland and Soröe, rise to a great elevation, and are inhabited by a few fishermen. On Qualöe is a commercial place, Hammerfest, the most northern town in Europe, which has about 400 inhabitants. The most northern island is Margeröe, a bare rock, which towards the north terminates in the North Cape, a huge mass of rocks rising to 1500 feet above the sea.

DRONTHEIM, the capital of the above country, and the most northern of the large towns of Europe, is built on the southern shore of Drontheim Fiord, at the mouth of the Nid Elf, which river nearly encircles it. On the land side it is commanded by a series of heights which make it incapable of defence in that direction, but towards the sea it possesses strong fortifications, both on the mainland and more especially on the small rocky islands of Munkholm and Christiansteen. The town has spacious, regularly-formed, and remarkably clean streets, with water cisterns at their intersections. It was once built almost entirely of wood, which, in consequence of the ravages of repeated fires, has chiefly given place to houses of stone or brick. The town is the seat of government for the province, and of a bishopric. The most remarkable edifice is the cathedral, where the kings of Norway are crowned. It is an object of great interest, but it has been much injured by the ravages of early barbarians, and defaced by the bad taste displayed in more modern renovations; it is, however, still venerable from the antiquity of some of its parts, which are as old as 1033, and on the whole is entitled to rank as the most remarkable ecclesiastical structure in the kingdom. The other chief edifices and institutions are the palace of the old Norwegian kings, when Drontheim was the capital, now converted into a military and naval arsenal; a museum, including a picture-gallery and a library with some rare manuscripts; literary and scientific institutions; asylums for the aged and deaf-mutes; grammar, Lancasterian,

and other schools; exchange, bank, a court-house, custom-house, handsome theatre, &c. The manufactures include excellent capes, hat-covers, &c. (of goat-skins), trinkets, &c. The breweries are famous for their beer, which is largely exported. There are also some extensive sugar-refineries, distilleries, and a shipbuilding yard. The harbour is indifferent, not admitting vessels drawing more than 12 feet of water; the roadstead is exposed to a heavy swell from the N. and E., and has loose ground in 20 fathoms of water. Drontheim Fiord never freezes, and the cold of winter, though severe, is not so great as in many places further south. The surrounding country is studded with merchants' villas, and the suburbs of Blakland and Ilen are built on picturesque heights above the old town. There is a carriage road from Drontheim to Stockholm, and steamers run to Hammerfest and other parts during the summer. The trade consists chiefly in exports of timber, dried and salted fish, tar, copper from Röraas, and mill-stones. The beauty of the women of Drontheim—many of whom are distinguished for their literary tastes—is celebrated, and the elegance of its society gives it much more the appearance of a capital than Christiania, which supplanted it in this respect on the union of Norway to Denmark. The population of the town is about 20,000.

So early as the year 996 Olaf Tryggvesson founded a palace to the S. of the Bratore, and a church which he dedicated to St. Clement. St. Olaf, who is regarded as the founder of the town (1016), revived the plans of Olaf Tryggvesson, which had fallen into abeyance after his death, and after the death of "the saint" at the battle of Stiklestad (1030) a new impulse was given to building enterprise. His remains were brought to Drontheim and buried there, but were soon afterwards transferred to a reliquary and placed on the high-altar of St. Clement's Church, where they attracted hosts of pilgrims, not only from other parts of Norway, but even from foreign countries. Down to the middle of the sixteenth century the name of the town was *Nidaros* ("mouth of the river Nid;" *aa*, *aar*, signifying river, and *os*, estuary) or *Kaupangr i Thrandhjem* ("merchants' town in Drontheim"), after which period the present name came into general use.

DROP, a small quantity of liquid. When the drop is produced by dropping it is that quantity which is sufficiently heavy to overcome adhesion. Thus a gentle dew will remain on a sloping surface, but a heavier dew will collect into masses, trickle down, and drip off the edge in drops. The circumstances determining the size and shape of drops are, however, far more complex than this simple illustration or definition would suggest. In an exhaustive essay read before the Royal Society (*Phil. Trans.* xiii. p. 444, &c.) Professor Guthrie has shown that drop-size, when a drop falls from a solid through a gas (as through air) depends upon the following conditions:—1. The rate of dropping; drops are larger the quicker they fall, and the larger the surface they fall from. 2. The more solid the matters the drop holds in solution the smaller it is, because the purer the liquid the greater its cohesion. Water has the greatest drop-size. 3. Drops vary also according to the chemical composition of the solid they fall from; thus antimony delivers the smallest, tin the largest drops. 4. The higher the temperature the smaller the drop for ordinary heats. The size of drops of a liquid dropping from a solid through a second liquid, when it will ascend or descend according to their relative specific gravities, depends upon conditions so complex as to be beyond the limits of this work to detail. The reader should consult Professor Guthrie's essay.

Every liquid behaves as if its exterior free surface were in a state of tension and exerting a constant effort to contract. It is this law which accounts for the curved free surfaces of liquids in tubes [see CAPILLARY ATTRACTION]; and since in the case of drops falling through a gas, as rain, for example, the whole external surface of the liquid is freely exposed, the tension is everywhere alike, and the drop becomes spherical. If anything alters the spherical shape of the drop it oscillates round that shape till it again recovers it, in a manner comparable to the vibration of a sounding bell. This is beautifully shown by Plateau's well-known experiments upon a drop of oil suspended in a liquid of its own weight, as mixed alcohol and water, for example. (See Tyndall's "Sound," p. 270, &c., fourth edition, 1883.) Professor Tyndall pursued these investigations in connection with "sensitive water-jets," as he calls them, that is, jets which may be controlled by musical sounds; and he shows in his preliminary observations that the shrinkings and swellings of a thin vein of water, falling vertically from a hole in the bottom of a vessel of water, which had long been noticed by observers, are really separate drops oscillating between an oblate and a prolate spheroid, that is, seeking to gain the spherical shape. The vein has really broken into drops, gravity having overcome cohesion. Its continuity still exists to the eye, because of the familiar phenomenon of "persistence," as when one makes a circle in the air with the point of a whirling stick. A quick series of flashes of electric light through a pierced revolving disc shows the separate drops as soon as the rapidity of the flashing reaches the rate of fall of the drops. When the drop first separates from the vein it is of course long in shape, gravity pulling against cohesion—that is prolate; hence it rebounds to the oblate shape, flattened at the poles like our earth, and from this to the first shape, &c., at each change more nearly approaching the sphere. A musical note of suitable pitch splits up the vein into drops much closer to the orifice than its natural division. Also if the jet be parabolic, as from a garden hose held in the hand, whence water issues upwards under pressure and falls in a parabolic curve, the jet will divide into three or more veins of visible drops which diverge at about the vertex of the curve. If now the suitable musical note be sounded the drops at once range themselves strictly in line, and the whole jet forms one thin apparently continuous curve. The instantaneous change is indescribably beautiful. When examined, as above described, by the electric light, the curve is found to be really composed of exquisite spherules, but to the unaided eye it is controlled into continuity by the sound. Thus drops are shown to be as sensitive to sound as flame or any other form of vibration or regularly successive motion.

DROP'SY (Gr. *hydrops*), a preternatural collection of watery fluid in different parts of the body. In the state of health there is constantly poured out upon every surface, cavity, and interstice of the body a watery fluid derived from the blood and deposited by the capillary bloodvessels. This fluid does not remain long where it is deposited, but, by vessels appropriated to the office, termed absorbents, is soon taken up and reconveyed into the common circulating mass. As long as there is a perfect balance of action between these two sets of vessels, which is always the case in health, there is no accumulation of fluid, the exhalation and the absorption being always exactly equal. But if from any cause that balance be disturbed, if either the capillary bloodvessels pour out an unusual quantity of fluid, or if the absorbents fail to act with their accustomed energy, an accumulation of fluid must necessarily take place, and this accumulation, when it amounts to an appreciable quantity, constitutes the disease called dropsy. We say "disease" to avoid periphrasis, but in reality dropsy is more properly a symptom than a disease, a result, not a cause, of morbid action.

This disease is known by different names, according to the situation in which it is found. When the effusion is chiefly in the superficial parts of the body, which are distinctly swollen from the accumulation of fluid beneath the skin, it is termed Anasarca; when the liquid accumulates

in the abdomen, Ascites; when in the chest, Hydrothorax; when the brain is distended with fluid, Hydrocephalus; and when the pericardium or membrane of the heart is affected, the complaint is known as Hydropericardium. Another form of this disease is that which arises in cases of marked anæmia, such as may be caused by fever, whether intermittent or continued, exanthematous or typhous, long-continued and excessive evacuations, whether of natural discharges or of preternatural effusions of blood, deficient or unwholesome diet, diseases of the digestive organs, by which the due assimilation of the food is prevented, intemperance in the use of intoxicating liquors, whence drunkards of all kinds, and especially spirit drinkers, so commonly die of dropsy.

There are many diseases of which dropsy is the sequent, especially affections of the heart and its great vessels, of the lungs, the liver, the spleen, the kidneys, the uterus, and the ovaries. When dropsy is the consequence of disease of the heart, the signs of disease of the heart commonly long precede the appearance of the dropsy. The effusion is commonly indicated first by swelling of the face, especially beneath the eyelids, and next by swelling of the feet and ankles, and of the hands and arms, particularly on the left side. As in the progress of the disease the effusion collects and accumulates in the cavity of the thorax, or in that of the pericardium, it is denoted by a peculiar train of symptoms. The respiration is always more or less embarrassed; the horizontal position uneasy, and often impossible; the pulse, which is seldom or never natural, is very variously affected.

Diseases of the coats of the great bloodvessels, constituting aneurism, concretions within their cavities, or tumours of neighbouring parts pressing upon their trunks and obstructing the passage of the blood through their canals, are frequent causes of dropsy.

Inflammation of the liver, generally of a slow or chronic nature, leading to a deposition of adventitious matter in its substance, and the consequent enlargement of the organ and the consolidation of its tissue, is a common cause of dropsy, occasioned by the obstruction to the circulation through the portal vein, the effusion being in this case often confined to the cavity of the abdomen.

The spleen, which consists of a congeries of bloodvessels, and which is very apt to be enlarged and obstructed, may occasion effusion into the abdomen, in the same manner as the liver.

The kidneys are subject both to functional and organic diseases, which are followed by effusion into all the cavities in consequence of the failure of these organs to remove from the common mass of blood the superfluous and noxious principles which it is their office to eliminate.

Dropsy, though often a terminal and always a serious symptom, is yet one which much can be done to alleviate, and in many cases to remove, and this is particularly the case in many local dropsies and in those of heart origin. Lung, kidney, and liver dropsies are less amenable to treatment; yet one case of ascites is on record in which a perfect recovery took place after the woman had been tapped 188 times and nearly 400 gallons of fluid removed. Diuretics and purgatives are the remedies chiefly employed; but in certain cases diaphoretics—and especially the use of a hot-air bath—are very effectual, and in a large number paracentesis or TAPPING is either indispensable, or at all events much expedites the cure.

DROS'ERA (from the Greek word signifying dew), a genus of plants belonging to the order DROSERACEÆ, and distinguished from its allied genera by the four to eight stamens, two to five styles, and the one-celled ovary with parietal placentas. *Drosera rotundifolia* (common or round-leaved sundew) is a native of Europe in boggy places. It is employed in Italy for making the liquor called *rossoli.* Two other species, *Drosera intermedia* and *Drosera anglica*, are natives of Great Britain. The first is a common bog-plant, but the latter is only common in Ireland. About 100 species of this genus have been described. They have been found in boggy places in all parts of the world, except in the extremes of heat and cold. They are all singularly beautiful and worthy of cultivation. The Drosera has a special interest as being a plant common in the United Kingdom, which belongs to the series known as insectivorous plants. It was long known to botanists that there were certain plants endowed with special apparatus for catching and killing insects, but how and why they caught them, and whether the captives served in any and in what way as food to the captors, was imperfectly understood. Charles Darwin solved these questions, and showed that the leaves which catch insects are provided with means of digesting and absorbing the greater part of the animal matter they seize; thus reversing the ordinary course of nature, and feeding vegetable tissues with animal nutriment, instead of digesting vegetable food into the nutriment of animal tissues. The insects are caught by means of "drops of viscid fluid surrounding the glands, and by the inward movement of the tentacles. As the plants gain most of their nutriment by this means their roots are very poorly developed; and they often grow in places where hardly any other plant, except mosses, can exist."

DROSERA'CEÆ, an order of plants consisting of marsh herbs, and belonging to the cohort Rosales among the POLYPETALÆ. Most of the 110 species included in this order belong to the genus DROSERA (the sundew). Another remarkable genus is DIONÆA (Venus' fly-trap), which consists of only one species, and is confined to one part of the world, namely, Carolina in the United States. The flowers in this order are regular, hermaphrodite, with parts in fives; the stamens are generally definite; the ovary is free, one-celled, with parietal placentas, distinct styles, and numerous ovules; the embryo is minute at the base of the perisperm; and the leaves generally have glandular hairs.

DROWNING, the state of ASPHYXIA produced by the immersion of the body under water. When a warm-blooded animal is immersed under water and forcibly retained there, it immediately begins to struggle violently, and uses every effort to rise to the surface. These struggles are not at first the result of suffocation but of fear. It is proved by direct experiment that the obstruction to the respiration which produces suffocation does not come on for a minute or rather less.

When a human being is drowned by accident, if the fall has been from a considerable height and the water is not of very great depth, the body is precipitated to the bottom of the water; it then quickly rises to the surface, partly because the specific gravity of the body, when the lungs are full of air, is less than that of water, and partly because the body is rendered still lighter by the air, always amounting to a considerable quantity, which is collected and retained in the clothes. If the person be not able to swim he generally struggles violently, and probably screams; by these efforts the lungs and clothes are partly emptied of the air they contained, the comparative weight of the body is increased, and consequently it again sinks to the bottom, but it soon again rises, and this alternate rising and sinking may occur several times in succession. Whenever the body comes to the surface, and the mouth is above water, the painful impediment to respiration produces an instinctive effort to inspire, and a hurried gasp is made to obtain air. But often the mouth is not sufficiently above the surface of the water to obtain air without inspiring a quantity of water along with it; but the quantity of water received in this manner is never great, probably not much more than is expelled by the cough excited by the irritation of the glottis in consequence of the contact of the water and by the subsequent expiration.

The change in the system produced by continued submersion, the consequent suspension of respiration, and the ultimate extinction of life, are all referable to one pathological condition, namely, a change in the nature of the blood. The water prevents air from entering the lungs, which therefore are incapable of converting venous into arterial blood, and can deliver to the left side of the heart only venous blood to be sent out to the body. [See CIRCULATION OF THE BLOOD.] But venous blood is incapable of maintaining vitality, and consequently death rapidly results.

After drowning there is always a quantity of water mixed with frothy matter in the windpipe and bronchi. Occasionally this frothy matter is mixed with blood. The quantity varies a good deal in different cases, but it is never very great. At one time it was thought to be so great as to be the cause of death in drowning. It was also supposed that water got into the stomach at the same time, and on this account the barbarous practice of suspending people who had been immersed in water by their heels was had recourse to for the purpose of getting rid of the water. But it is now known that little water (often none at all) gets either into the tissues of the lungs or into the stomach.

As the arterial blood at first in the lungs, left side of the heart, and arteries passes from them in the course of the circulation and is replaced by venous blood, growing ever and ever barer of oxygen as it circulates, the struggles to breathe increase. At last expiratory movements ensue so convulsive that every muscle of the body is brought into play. The nervous centre of these almost purely expiratory struggles is now known to be in the medulla oblongata, the tract of the spinal cord which lies between the spine proper and the brain. Double proof of this exists—1, when the brain is removed the same convulsions still occur; 2, if asphyxia of the medulla is brought on by cutting the arteries which supply it, so that the blood contained in its vessels deteriorates into a venous condition, exactly similar convulsions occur. The nervous system is speedily exhausted from such violent convulsions, and the period of their duration is very brief. It is succeeded by a profound calm, during which sensibility is found to be entirely lost. The eyeball may even be touched without causing the eyelid to move, and (a more delicate test still) the pupil no longer contracts under bright light. Inspiratory efforts occasionally occur, growing slower and deeper till the whole body stretches in the effort, and "with extended limbs and a straightened trunk, with the head thrown back, the mouth widely open, the face drawn, and the nostrils dilated, the last breath is taken in" (Professor M. Foster's "Physiology," London, 1879). Thus drowning or any kind of suffocation (asphyxia) has three stages—1, dyspnœa, with rapid inspiratory and expiratory efforts; 2, violent convulsive expiratory efforts; 3, exhaustion, passing gradually into steadily convulsive inspiratory efforts, growing longer and deeper till they cease. Strangling a dog produced all these stages in from four to five minutes; a rabbit, in from three to four minutes. The second stage was reached in one minute, and lasted only one minute. But in the case of a dog which died in a little over four minutes the heart continued beating over seven minutes; so also with the rabbit. The force of the heart is very slight, however, in these last struggles, for it is paralyzed by being gorged with accumulated foul blood. It is probably this paralysis which finally stops its beating. The violent expiratory convulsions of the second stage press upon the lungs, already full of blood, with a fatally congestive effect. The heart ceases to supply the arteries, which drain themselves dry; and a further reason for the emptiness of the arteries is that the great vaso-motor (sympathetic) centre, poisoned by venous blood, spasmodically contracts them, and the blood is checked from entering them. The heart is thus choked, and although at first its left (arterial) side is comparatively empty, it gradually becomes as gorged with venous blood as the right side. At death the whole heart and veins are violently distended with blood, the latter spurting if pricked; while the arteries are so bloodless as to have given rise to the mistake of the ancients that they were air-tubes (Gr. *arteria*, a windpipe). Drowning, from the fact of the water in many cases getting into the lungs, asphyxiates quicker than strangling. Young animals, whose respiratory changes are less active than old ones, resist drowning therefore better. An old dog will drown past recovery in one minute and a half, but a puppy has recovered after fifty minutes' immersion. From the same cause a person who has fallen into the water in a state of syncope, as in a fainting fit, for instance, has a much better chance of recovery than one whose circulation is in full activity. It is such cases as this which give the extraordinary recoveries from long immersion sometimes recorded. Thus in Plater's case, a woman condemned for infanticide was tied in a sack and drowned, while fainting, in the Rhine. She was restored to life after a quarter of an hour's submersion. Pouteau records a case at Lyons of recovery after three hours' immersion under ice, and there are numerous others equally well authenticated. Ordinarily, however, less than two minutes' total submersion is sufficient to kill a man. By practice divers can remain nearly this time under water without any artificial aid. The usual time in the Ceylon pearl-oyster fishery is from a minute to a minute and a half. Among other precautions care is taken to close the nostrils and ears, and the diver will sometimes make forty or fifty plunges a day. Yet exceptional divers have been known to remain, in very rare but perfectly well-authenticated cases, nearly six minutes under water. But though the body as a whole is dead, and even if the heart has for some time ceased to beat, the tissues have not yet died, and consequently in by far the greater number of cases of drowning animation may be restored if the body is quickly recovered and proper means are at once employed and continued with perseverance. At least four or five hours, if necessary, should be spent in unremitting efforts, indeed cases of restoration to life after six hours' suspended animation are well authenticated. A man so restored to life was asked if drowning was a painful death, and replied that it was not. He seemed to have been stunned by the shock, for he remembered no pain at all; "but coming to life again," he said, "was greater agony than it is possible to express." Sir Benjamin Brodie also mentions such a case, in which the last thing a man remembered as he lay drowning was that he counted the pebbles at the bottom of the water. He felt perfectly powerless, but was not in pain.

The proper remedies for the recovery of the drowned are few and simple. The body, placed on a bed-chair, should be removed to the receiving-house or any place where the conveniences required may be most easily obtained. The wet clothes should be stripped off as rapidly as possible, the body well dried and surrounded by warm air, if it can be readily procured, by the portable warm-air bath, of which there ought to be one at every receiving-house. At first the heated air should only be a few degrees above the temperature of the body, and the heat, which ought always to be ascertained by a thermometer, should be subsequently increased with caution. The body being thus surrounded with warm air, artificial respiration should be performed without the delay of a moment, and this should be assisted by electricity applied at first in the form of very gentle shocks. [See RESPIRATION.] There are some few other useful auxiliaries, but so important and efficacious are the agents already mentioned, when judiciously and perseveringly employed, that they may be considered as the only remedies worth regarding.

DROYLS'DEN, a town of England, in the county of Lancaster, 194 miles from London. It is a manufacturing town rising rapidly into importance, situated 4 miles E. of

Manchester. It contains 6768 inhabitants, and has a neat parish church and several dissenting chapels and schools. The Droylsden Institute is a handsome Gothic building, containing a lecture hall, library, and news-room. There are spinning mills and dye-works.

DRUGS. The distinction between drugs and chemicals is very indeterminate. It would appear that natural substances in a more or less unprepared state used in medicine, whether from the animal, vegetable, or mineral kingdom, are termed drugs, such as the different kinds of barks, leaves, roots, woods, flowers, and juices of the same; or the animal and vegetable oils, gums, resins, &c. Chemicals are generally artificial compounds produced by the art of the chemist.

In the Medical Act passed in 1858, the general council was empowered to publish and issue under their direction a book containing a list of medicines and compounds, and the method of preparing them, called the "British Pharmacopœia."

In several countries of the Continent the sale of drugs is placed under strict enactments, for the safety of the public in regard to the sale of poisonous and also adulterated compounds. The English law as to the sale of poisons was formerly rather lax, but was rendered much more stringent by the PHARMACY ACT, which came into operation in 1869. The value of the drugs imported into the United Kingdom is between £400,000 and £500,000 per annum, and that of those exported £300,000. Patent medicines are exported to the value of over £700,000 a year.

DRU'IDS were the priests of ancient Britain and Gaul. Cæsar, though himself High Pontiff of Rome, and author of the standard work of his time on divination, has most unfortunately left us without accurate knowledge of the Druids and the religious system of which they were the servants. Still worse is the case of Cicero, who was personally friendly with the Druid Divitiacus, and is known to have held long talks with him, of which he has culpably neglected to preserve one word. Cæsar only cared to observe that the gods of Gaul (and Britain) were much the same as those of Rome; consequently no difficulties with the new provinces would arise on the score of religion. His sketch, so often read and discussed, is therefore most meagre. He notices that education was confined to the Druids, and more especially to those in Britain. They were esteemed to possess the holier and more ancient tradition, so that Gauls went over to them to be taught. Much political power was theirs too. Cæsar declares the Druids to have had a supreme head, who was elected by the whole body and ruled for life. All the order assembled at a place in Gaul once a year. The lore of the Druids was communicated by verses learned by heart; they neither possessed nor allowed writings. They taught, says Cæsar, the transmigration of souls (an old doctrine of the Greek Pythagoras also): partly, so the astute Roman thought, because if a warrior were sure he would live again as soon as he was dead, and possibly in a better body than that which he then held, he would know no fear in battle.

Mr. Elton, in his "Origins of English History" (London, 1882), has exhaustively collected every scrap of the scanty store of information we have of the Druids. We find, as indicated by Cæsar, that the greater gods were revered in Gaul and Britain; a Pluto reigned in darkness, an Apollo in light, a Jupiter ruled in heaven, Mars controlled battle, Mercury trade, Minerva knowledge—under Celtic names, but without any great distinction of attributes from those of the Roman gods on a cursory survey. The Druids taught that the Celtic nations arose from Pluto, which is why (thinks Cæsar) time was measured among them by nights, not days. But to this day we consider all things came from darkness and chaos, and as for reckoning time the Druids used the moon as their standard, and therefore were forced to enumerate nights. Their starting point was the sixth night after what we call "new moon," that is, when the moon is on the point of becoming half-full; and the year consisted of thirteen lunations.

The mistletoe was sacred to the god of light, whom Cæsar translated Apollo, but whose name was in some places Belenus (compare Ausonius' description of Belenus' fine temple at what we now call Bayeux, and the founding of a gate of wonderful design upon the banks of the Thames, which men to this day call Billingsgate after his name, according to the veracious Geoffrey of Monmouth), in others Grannus (for it seems probable that the well-known spring "Aquis Grannum," which gives its name to Aix-la-Chapelle, is called after the Gaulish Apollo, whose temple stood near, rather than after the Roman general Granius, as sometimes asserted), in others Belisa (as at Aquileia, in Italian Gaul), and in others Borvo, whence the many "Bourbon" springs derive their name. Probably, like the classic deities, Belenus had many epithets; so also Apollo was called Phœbus, Pythoctonus, Dianus, &c. Like Apollo he was god of healing (hence of medicinal springs) as well as of light; and his sacred mistletoe was held to be sovereign against almost every ill of men and even of cattle. In his "Natural History" Pliny tells how its appearance in the sacred oak betokened the presence of the god, and how the service of its cutting took place at the beginning of the month, all men making holiday. A Druid clothed in white, a wreath of oak leaves crowning his brow, mounted a ladder to the tree, and cut the holy plant with a golden sickle exactly the shape of the new moon (*i.e.* what we call a six days' moon), and the severed branches he received reverently in the folds of his white mantle. Then followed sacrifices and prayer, and all closed with a banquet; after which the mistletoe was carried home on a waggon drawn by two snow-white bulls which had never before known the yoke.

Less known to most readers, but second only to the mistletoe in honour, was a species of club-moss, which Pliny calls "selago," gathered by the people themselves with great ceremony. The worshipper must be all in white and barefoot, and must snatch it up with the right hand with a stealthy sudden clutch beneath the left arm. It is curious to add that Villemarque ("Bazas Breiz," 62) says of the Bretons of to-day that they esteem the club-moss in just the manner of their ancestors, "et pour le cueiller il faut être nu-pieds et en chemise: il s'arrache et ne se coupe pas." He who carried selago was proof against misfortune; and blindness could be cured by its burning smoke.

Teutates was the continental name, Camulus the British name for the Celtic Mars. (Camulodunum and other towns in Roman times preserved his name among us.) For him the terrible human sacrifices were made, and the piles of spoil heaped in the market-places.

Taranis answered to Jupiter, but was also the god of fire and thunder as well as of the sky. As his name indicates, he is akin to the red-bearded Thor of Scandinavia, and is to this day worshipped by the Slavonians under the pseudonym of the Prophet Elijah with his chariot of fire and his power over the thunder.

Professor Rhys ("Lectures on Welsh Philology," London, 1877) shows that it is not proved that Druidism was known in Gaul before 200 B.C.; and from this and other reasons he concludes that it was the religious system of the autochthonous race, whatever it was, which preceded the Celts, and was adopted by the latter while yet the Gael and the Cymry were one folk. This would account for the special purity of the British Druidical faith. The Druids, as later Roman observers depict them to us, are as settled a caste as the mediæval monks in their palmiest times; they even used (like the monks) a tongue unknown to the people, which passed therefore for a sacred tongue, the "language of the gods." They practised augury and divination, the latter in a horrible manner; for they used to devote a captive to the gods, strike him down, and observe the omens

indicated by the way the poor wretch fell or struggled. Human sacrifices were, we are told, common occurrences, and at particular seasons a group of many such sacrifices took place simultaneously with great solemnity. In some places victims were crucified or shot with arrows; but the most esteemed manner was by burning, the victims being stuffed into wicker hollow figures like giants, or driven with cattle, &c., into an inclosure roughly the shape of the human form, and there burned in a great holocaust. Almost to our own day in the Highlands the relic of this sacrifice remained. At the May-day bonfires (Beltein) lots were drawn, and the loser had to imitate a sacrifice by leaping thrice through the Beltein fire. St. Patrick (so say the "Acta Sanctorum") lit the holy Easter fire when the Irish king and his Druids were beginning the Beltein sacrifices in Tara, and almost paid the forfeit of his life for lighting a flame elsewhere than from that sacred bonfire which should have re-illumined all the extinguished fires of the land. After the conversion of Ireland the Druids disappear—their maxims of government, it is conjectured, may be preserved in the very ancient Brehon laws.

It seems, then, fair to conclude that Druidism was a worship of the forces and elements of nature; and the first historian of Britain, our sole recorder of the English (Saxon) Conquest, Gildas, has correctly summed up the old faith of these heathen, whom he and his church had converted, only to see the land once again plunged into darkness by the invading English. He says, in his misty Ossianic style—"A blind people, they paid divine honour to the mountains, wells, and streams. Their altars were pillars of stone inscribed with emblems of the sun and moon, or of a beast or a bird, which symbolized some force of nature. They bound themselves by vows to the heavens and the earth, to day and night, to the rain, the dew, and the wind."

DRUM was the name given to an evening assembly in the last century, not a ball, but gayer than those now called "at homes." They were indeed so crowded and noisy as to deserve their nickname. Much gambling often went on at them. Other names for the drum were *rout*, *hurricane*, &c. The word has been used in our own day jocularly to signify an "afternoon tea;" these mild parties being called "kettle-drums," from their obvious connection with the tea-kettle and their equally obvious opposition to the noisy evening drum of the beaux and belles of the time of Queen Anne.

DRUM, a pulsatile musical instrument of which there are three kinds—the side drum, the bass drum or big drum, and the kettle-drum. The first is a cylinder made of brass, on each end of which is a hoop covered with vellum or parchment, and is the well-known military instrument. It is played by single taps or by a roll. The latter is performed by two taps of the left hand quickly followed by two of the right in rapid succession, and from its sound when played slowly is nicknamed "Daddy Mammy." It is, in fact, the "double tonguing" of the side drum. In military matters there are various beats of the drum, which indicate certain signals perfectly intelligible to officers and men, and which form or formed a most important feature in military science. (They are now greatly superseded by bugle calls.) For instance, the beat of the drum called the *general*, is intended to give notice to the troops that they are to march. The *march* is the command to move. The *assembly* is the order for the different corps to repair to the place of rendezvous, or to their respective colours. The *alarm* is intended to give notice of danger, so that every man may be ready for immediate action. *To arms!* is the summons for soldiers who are dispersed to collect together, and be prepared for action. The *parley* is a signal denoting a wish to hold a conference with the enemy. *Tattoo* is the general order for all to retire to their respective quarters. The *réveillée* is always sounded at the break of day, and is intended to warn the soldiers to rise and the sentries to forbear challenging. The *retreat* is usually beat, in both garrison and camp, a little before sunset, at which time the soldiers repair to their quarters, and the gates are closed. It is also the signal for an army to draw off from the enemy and take up other positions. The bass drum is formed like that of the side drum, but of oak, on a much larger scale, the thickness being shallow in proportion to the large diameter.

Kettle-drums are made of copper, nearly hemispherical, covered with a strong head of calf's skin. They vary in dimensions from 19 inches to 3 feet in diameter. They are always in pairs, and are tuned by means of many screws which tighten the head, to the key-note and the fourth below. The kettle-drums are thus made into a musical instrument capable of giving a dull DRONE-BASS, and have been used for far higher than merely pulsatile purposes by the greatest composers. In Beethoven the drum is made to give out a musical subject; no composer has yet equalled him for variety and beauty of drum effects. Berlioz, on the other hand, turned his attention rather to the possible drum-harmony than drum-melody; and in his stupendous "Requiem" (1837) has used eight pairs of drums, so as to command drum-chords in every key. The effect is indescribably solemn, the soft roll of the harmony being something almost unearthly. It was performed at the Crystal Palace in December, 1883.

DRUM is a term used to denote the long ridges into which the glacial drift frequently rises. They generally occur near mountains where the ice sheet has sent masses in various directions, and their length marks the direction in which the ice moved.

DRUM-FISH (*Pogonias chromis*), a species of the family Sciænidæ (of which the MAIGRE is the common British representative), is especially remarkable for the extraordinary drumming sounds it produces. This production of loud musical sounds, though not peculiar to the drum-fish, is most marked in it. How the sounds are produced has not been clearly ascertained. "Some naturalists believe that it is caused by the clapping together of the pharyngeal teeth, which are very large molar teeth. However, if it be true that the sounds are accompanied by a tremulous motion of the vessel, it seems more probable that they are produced by the fishes beating their tails against the bottom of the vessel, in order to get rid of the parasites with which that part of their body is infested." Such is the prosaic explanation suggested by Dr. Günther. The drum-fish attains a length of 4 feet, and a weight of over 100 lbs. The snout is convex, and the upper jaw overlaps the lower.

DRUM'MOND, CAPTAIN THOMAS, was born at Edinburgh in October, 1797, and was early entered at the High School there, where he formed an acquaintance with Professors Playfair, Leslie, and Brewster, also with Professors Wallace and Jardine, whose pupil he more especially was. In February, 1813, he was appointed to a cadetship at Woolwich, where his mathematical abilities soon made him conspicuous. In 1820 an offer from Colonel Colby to take part in the trigonometrical survey was gladly accepted. This brought him to London each winter, and gave him opportunities, eagerly embraced, for continuing his studies in the higher mathematics. During this period he devoted considerable attention to the study of chemistry, and attended the lectures of Professors Brande and Faraday. From what he learned on these occasions he was led to the idea of employing as a signal light a ball of lime in a state of incandescence at the focus of a parabolic mirror. This was the origin of the excellent LIME-LIGHT, which still forms one of the handiest and best illuminants of great intensity.

In 1824 a committee of the House of Commons recom-

mended that a trigonometrical survey of Ireland should be begun. In a climate so misty as Ireland, the difficulty of distant observations greatly increased, and "Drummond's light" was of signal service, Slieve Snaught in Donegal, which had long in vain been looked for from Davis Mountain, near Belfast, at a distance of 66 miles, being quite well indicated by the steady blaze of the new light.

Mr. Drummond was superintendent of the commission for laying down the boundaries of the old and new boroughs previous to the Reform Bill. In 1835 he was made under-secretary for Ireland, and distinguished himself greatly in the report on railways in Ireland, being at the head of the commission. He died 15th April, 1840.

DRUM'MOND, WILLIAM, of Hawthornden, the son of Sir William Drummond, was born on 13th December, 1585. He was educated at Edinburgh, and studied civil law in France. On his father's death in 1610 he relinquished his profession and devoted himself to literary pursuits. He afterwards travelled on the Continent and collected a library of great value, of which part is now in the possession of the University of Edinburgh. When the Civil War broke out, his political bias exposed him to grievous annoyances, particularly that of being compelled to supply his quota of men to serve against the king.

Southey has observed that he was the first Scotch poet who wrote well in English. His sonnets are of a melancholy character, said to have been owing to the loss of his betrothed bride on the eve of his marriage. In 1616, at Edinburgh, he published his "Poems: amorous, funerall, divine, pastorall, in Sonnets, Songs, Sextains, Madrigals, by W. D., the author of the 'Teares on the Death of Moeliades.'" This last was a lament for Prince Henry of Wales, and Moeliades is an anagram on "Miles a Deo" (God's soldier), which the prince had himself contrived. In 1619 Ben Jonson was a guest of Drummond, and most fortunately the latter kept notes of their talk. The resemblance which Drummond's versification presents to that of Milton's minor poems is striking, and few can read his "Moeliades" without being reminded (with due gradation) of "Lycidas." He also wrote a history of the five Jameses, kings of Scotland, and some other prose works. He died at Hawthornden on 4th December, 1649.

DRUNK'ENNESS. So alarmingly prevalent has this vice become that of late years legislative enactments of various kinds have been suggested both for its punishment and cure. The Licensing Act, 1872, was framed somewhat with the view of curtailing the facilities and temptations to over-indulgence in intoxicating drinks; but a parliamentary committee which sat in 1872 went much further than this, and recommended the adoption of very stringent measures for the suppression of drunkenness. Instead of the usual penalty of 5*s.*—which was enacted in the time of James I., when the value of money was very different from what it is now—the committee proposed to punish the first offence, or "casual" drunkenness, with a fine of 40*s.*, or in default thirty days' imprisonment. In the event of two other such convictions following the first within twelve months, the "habitual" drunkard to find sureties for sobriety and good conduct for a fixed period, or in default to be committed for a "considerable period" to an "industrial reformatory for inebriates," where labour would be added to the penalty of detention.

Parliament somewhat naturally hesitated to adopt recommendations so stringent, and they slumbered till 1879, when the Habitual Drunkards Act was passed. This Act, which is unfortunately entirely "permissive," authorized the licensing of "retreats" for habitual drunkards, where such persons may be placed under discipline and reformative treatment. Once within the retreat the patient may be detained there for periods ranging to twelve months, unless previously released by a judicial order, and he is liable to a penalty of £5 for disobedience to rules or for attempting to escape. Instead of a drunkard being *committed* to a retreat, however, entrance is only to be obtained on a person's voluntarily written application, attested by two witnesses.

It may be hoped that the British people will before long be relieved from the reproach of being "the most drunken nation in the world." Temperance societies have long laboured for this most desirable object, and not without substantial fruit. The "Temperance Refreshment House" movement [see TEETOTALISM] has done a great work towards the same end, by offering facilities for obtaining other than alcoholic refreshment at places quite as cheerful as public houses; while the House of Commons, both in 1880 and 1883, showed its sympathy with means tending to reduce drunkenness by passing resolutions in favour of "local option" and of the Sunday closing of public-houses in England and Wales. In the latter year the chancellor of the exchequer in introducing his annual budget had to refer to a very large falling off in the revenue from alcoholic liquors, and paid a generous tribute to the substantial work being done by temperance societies, blue-ribbon missions, and similar organizations.

In America asylums for the detention and reformation of drunkards have existed for some years. Drunkenness is there regarded more as a disease than a crime, and is studied and treated professionally with a view to cure rather than punishment. The following are the "articles of faith" of the American Association for the Cure of Inebriates:—"1. Intemperance is a disease. 2. It is curable in the same sense that other diseases are. 3. Its primary cause is a constitutional susceptibility to the alcoholic impression. 4. This constitutional tendency may be inherited or acquired. 5. Alcohol has its true place in the arts and sciences. It is valuable as a remedy, and, like other remedies, may be abused. In excessive quantities it is a poison, and always acts as such when it produces inebriety." The asylums managed by the American association not only pay, but in some cases the average payments enable a certain number of charitable cases to be admitted at reduced rates. Entrance is principally voluntary, only about 12 per cent. being committals.

DRUPE, in botany, is the name given to those fruits which are fleshy and inclose a "stone." The fleshy and stony parts are originally of the same nature in the very young ovary which incloses the ovule; but as the ovary ripens into the fruit, and the ovule grows into the seed (or kernel), the wall of the ovary becomes differentiated into a succulent outer portion and an inner stony part. A good example is the plum. Very small drupes, such for instance as collectively make up a blackberry, are called *drupeoles.*

DRU'SES, a people inhabiting the chain of Lebanon, in Syria, who are under the government of their own chiefs, and have a religion peculiar to themselves. The vernacular language of the Druses is Arabic. Although the mountaineers of Lebanon till recently obeyed the Emir or Prince of the Druses, yet they are not all Druses, but the greater part are Christians of the Maronite communion, and belong to the Western or Roman Church. [See MARONITES.] The Druses live chiefly in the south patr of Lebanon, east and south-east of Beirut, and as far south as the sources of the Jordan. The capital of the Emir of the Druses is Deir-el-Kamr, in a fine valley on the western slope of Lebanon, about eight or nine hours' ride south-east of Beirut.

The Druses were originally disciples of Hakem Biamr Illa, the sixth Fatimite caliph of Egypt, who in the eleventh century proclaimed himself to be an incarnation of the divinity, and who established a secret lodge at Cairo. Into their faith are curiously interwoven many of the doctrines of the Jews, Christians, and of the Sufi allegories. Their moral commandments are seven in number:—1. Veracity (to each other only); 2, mutual protection and resistance; 3, renunciation of all other religions; 4, profession of the

unity of Hakem (their founder) as God; 5, contentment with his works; 6, submission to his will; 7, separation from those in error, and from demons. They believe in the transmigration of souls in the sense that the number of existing souls never varies, and that all souls now in existence have lived, vested in some human form; and that when a man dies his soul puts on a fresh humanity, which occupies a moral rank corresponding to the purity or impurity of his past life. They also believe that after a lapse of ages it will be purified of every stain, and there will then come a period of rest.

In 1860, when fearful barbarities were said to have been inflicted by the Druses upon the Maronites, France, with the consent of the great powers, sent an expedition to protect them and to restore tranquillity. It was found, however, that the principal crimes had been committed by the fanatical Turks, and not by the Druses, while the Maronites had been guilty of horrible acts of retaliation. When peace was restored a separate governor was appointed over the Maronites, which, with other measures then adopted, has had the effect of preventing any further disturbances of importance.

The Druses are a brave, handsome, and industrious people, and generally well educated. They have, with great industry, laid out the hill-sides in terraces, and planted them with mulberry, olive, and vine, from the produce of which they draw the greater part of their sustenance. The chief trade is the manufacture of silk.

DRU'SUS, a name of great honour among the Romans, was the favourite family name of the Livian gens (as Cæsar was of the Julian, Gracchus of the Sempronian, &c.) There are therefore many distinguished men of the name of Livius Drusus, and of these the following are the most remarkable.

M. LIVIUS DRUSUS was tribune with Caius Gracchus, B.C. 122, opposing his reforms in every way. When the senate found that the people were in earnest, and that it was necessary to give way to avoid a revolution, they intrusted similar measures to Drusus, who thus took the wind out of the sails of his noble-minded antagonist. Drusus was rewarded with the consulship, 112.

M. LIVIUS DRUSUS, son of the above, continued his father's course of public reforms in the distribution of state lands, increased coinage, &c., but he became deeply in earnest and almost a second Caius Gracchus. Like him he perished by the hatred and fear of the senate. They took advantage of the temporary jealousy of the Romans, his fervent admirers, at an alleged forthcoming proposal to extend the Roman franchise to all dwellers in Italy, to obtain the reversal of all his reforms. Drusus regained his popularity instantly, however, but was assassinated, B.C. 91, as he was bidding good night to the crowd which as usual had followed him home. The assassin escaped. The oppressed Italians had looked on Drusus as their deliverer. Revolution almost at once broke out in the form of the Social War, which, after a bloody struggle and some grudging and insufficient concessions, was in two or three years with difficulty got under.

LIVIUS DRUSUS CLAUDIANUS was really a Claudius, but was adopted by a Livius Drusus. His daughter, Livia Drusilla, was the celebrated empress whose house (Domus Livia) yet stands almost intact upon the Palatine at Rome. She married Tiberius Claudius Nero, but although she was already a mother, and was within a few months of becoming a mother again, Augustus commanded Nero to divorce her, and himself married her. Tiberius was her first son, and the son born three months after her marriage with Augustus was called Drusus. She had no children by Augustus, but her son Tiberius succeeded him in the empire. Livia's father went with the party of Brutus and Cassius at the time of Cæsar's murder, and committed suicide after the rout at Philippi, B.C. 42.

NERO CLAUDIUS DRUSUS (B.C. 38 to B.C. 9), that son of the Empress Livia mentioned in the previous article. He was as amiable and beloved as Tiberius was austere and feared. He is generally called *Drusus Senior*, to distinguish him from his nephew next to be mentioned. Augustus esteemed Drusus highly, treated him as his son, caused him to marry Mark Antony's daughter (a union proverbial for its fidelity), and sent him as commander-in-chief to Germany against the barbarians. Here he won great honour, sweeping the Germans before him, so that he was honoured with the surname of Germanicus; but meeting with a severe fall from his horse, he sank slowly under the shock, and died B.C. 9. Tiberius hastened from Rome to his deathbed, and seems to have sincerely regretted the brilliant young prince. He brought the body to Rome, and after cremation the ashes were deposited in the mausoleum of Augustus. (This mausoleum yet in part exists, and now serves the purpose of a Roman circus.) The eldest son of Drusus Senior inherited his father's surname, and is best know as Germanicus to us.

DRUSUS CÆSAR or *Drusus Junior*, was nephew and son-in-law of Drusus Senior, being the son of the Emperor Tiberius by his first wife. He married Livia or Livilla, daughter of Drusus Senior. When Sejanus rose to the head of the administration, and had so gained the confidence of the reserved Tiberius that he felt a complete mastery over him, the awful design struck him of removing the emperor's relatives by death, so that he might himself gain the imperial succession. He began with Drusus, who in A.D. 22 had received the perpetual tribunate, and was designated the heir of Tiberius. Sejanus succeeded in seducing Livilla, and with the assistance of the wretched woman poisoned Drusus A.D. 23.

Finally, DRUSUS CÆSAR was the name of the second son of Germanicus and Agrippina. He was therefore the grandson of Drusus Senior (whose son Germanicus was). Consequently when the son of Tiberius himself (Drusus Junior) was poisoned by Sejanus, the succession reverted to the sons of the brother of Tiberius (Drusus Senior), and consequently descended to his grandchildren, the family of Germanicus—namely, Nero Cæsar, Drusus and Caius Cæsar, and Agrippina the Younger. Sejanus continuing his plots, with the greater confidence now that the emperor had for ever left Rome, gained the confidence of young Drusus, and allured him by suggestions of future empire to betray his brother. Tiberius was filled by Drusus and by Sejanus with the worst suspicions of Nero Cæsar, who was therefore in A.D. 29 starved to death by order in the island of Pontia. The virtuous Agrippina and her son Drusus were next the victims of the tyrant, still under the sway of Sejanus; and in the following year were condemned as enemies of the state and banished to the island of Pandataria, A.D. 30. They both died, probably starved to death by order, three years afterwards. (Sejanus' treachery was discovered and he perished A.D. 31.) There still remained a brother and sister of Drusus and Nero to preserve the line of Germanicus—viz. Caius Cæsar (who succeeded Tiberius, and is nicknamed CALIGULA), and Agrippina the Younger, the infamous woman who became the wife and murderess of the Emperor CLAUDIUS, and the mother and possibly paramour of the Emperor NERO.

DRU'SY is a term applied to any space or surface covered over, more or less thickly, with small crystals. A cavity is called drusy when lined with crystals projecting towards the centre of the cavity. Many rocks contain such cavities, and in them the component minerals of the rock frequently have a chance of developing with greater perfection than in its mass, where their freedom is encroached on by the formation of other crystals. Thus the cavities of granite often contain good crystals of quartz, mica, felspar, topaz, beryl, and tourmaline, the free ends of which (those projecting into the cavity) are very perfect.

DRY AND WET BULB HYGROMETER is often called *dry and wet bulb thermometer*, because it consists of two thermometers, though its office is not *thermometrical* (heat-measuring) but *hygrometrical* (moisture-measuring). It measures the moisture in the air by the difference in the reading of two exactly similar thermometers, the bulb of one of which is surrounded by moist rag (whose moisture constantly evaporates), and is therefore artificially lowered in temperature. The difference decreases when the air is full of moisture because evaporation is checked, and increases in dry weather when the evaporation is encouraged. For other forms of the instrument see HYGROMETRY, but the dry and wet bulb hygrometer is practically the only one in general use.

DRY PILE, in electricity, is a method of obtaining a current from electric couples without the use of cells or fluids. Zamboni's dry pile, still the best variety, is described in the article BATTERY.

DRY ROT, a well-known disease affecting timber, in which the wood is converted into a dry mass of powder. When dry rot is produced, the first sign of it consists in the appearance of small white points, from which a filamentous substance radiates parallel with the surface of the timber. This is the first stage of growth of the spores of a fungus, and the filamentous matter is their mycelium or spawn. As the mycelium gathers strength it insinuates its filaments into any crevice of the wood, and they, being of excessive fineness, readily pass down and between the tubes from which the wood is organized, forcing them asunder and completely destroying the cohesion of the tissue. When the mycelial threads of many fungi interlace, the radiating appearance can no longer be remarked; but a thick tough leathery white stratum is formed wherever there is room for its development, and from this a fresh supply of the destructive filamentous mycelium is emitted with such constantly increasing rapidity and force, that the total ruin of timber speedily ensues where circumstances are favourable for the growth of the fungi.

The fungus which generally attacks the timber of ships cut from fir-trees is *Merulius lacrymans*, while that which is found in oak-built ships is *Polyporus hybridus*. It is supposed that dry rot begins with a decomposition of sap which has not been thoroughly dried out of the wood. Whether this be the case or not, it is certain that timber cut between autumn and the end of winter is not so liable to the disease as if it were cut while the sap is flowing freely.

The circumstances that are most favourable to the development of the dry-rot fungi are damp, unventilated situations, and a subacid state of the wood. There have been suggested numerous processes for the prevention of dry rot, among the most successful of which may be cited Kyan's process, or the use of a solution of corrosive sublimate; Payne's process, or the use of the sulphate and muriate of lime and the sulphate of iron in solution; Margary's process, or the use of a solution of the sulphate of copper; Burnett's process, or the use of a solution of the chloride of zinc; and Bethell's process, or the use of creosote, with a small proportion of the pyrolignite of iron. There are some valuable treatises by Faraday and Birkbeck on the subject of the prevention of dry rot.

DRY'ADS, the nymphs of trees (Gr. *drus*, an oak or any forest tree). Hamadryads were nymphs of some particular tree, born with it and dying with it; Dryads, however, were nymphs of forest-trees in general. See NYMPHS.

DRY'DEN, JOHN, one of the greatest and most versatile writers in English or any other literature, was born in 1631, at Aldwinkle in Northamptonshire. His father, Erasmus Driden, was third son of Sir Erasmus Driden, of Canons Ashby, in that county, who was created a baronet in 1619. The poet was educated at Westminster School under the celebrated "flogging" Dr. Busby, and went up as a Westminster scholar to Trinity College, Cambridge, in 1650. It is due to Busby to add that, severe though he was, Dryden always regarded him with respect and affection.

In 1654 his father's death put him in possession of an estate worth about £80 per annum. He did not, however, leave Cambridge till 1657. The "Heroic Stanzas on Cromwell's Death," his first poem of any importance, were written in 1658, and yet in 1660 he signalized himself by "Astræa Redux," a congratulatory address on the Restoration, followed by other laudatory poems, "Panegyric on the Coronation," &c. Dr. Johnson, who admired Dryden greatly and hated Cromwell with almost unreasoning rage, thus defends "glorious John's" conversion, in the short space of two years, from panegyrizing the great Protector to welcoming the Stuarts:—"The reproach of inconstancy was on this occasion shared with such numbers that it produced neither hatred nor disgrace; if he changed, he changed with the nation." This is indeed all that so acute a mind as Johnson's can find by way of excuse. In 1663 Dryden married Lady Elizabeth Howard, daughter of the first Earl of Berkshire; and in the same year he began his dramatic career with "The Wild Gallant," a failure"—as poor a thing," writes honest Pepys, "as ever I saw in my life." But it was not long before the "Indian Emperor" showed that in serious drama the stage had found a new master. The splendid eloquence of many passages of its heroic couplets is yet undimmed by age. The plague and fire of London interrupted him for a time, and he employed himself upon his "Essay on Dramatic Poesy," a performance containing much elegant writing, and worthy of notice as the earliest regular work of the critical kind in our language, and for its manly avowal of his own inferiority as a comic writer, and the free and full recognition —the first since the Restoration—of the supremacy of Shakspeare.

In 1667 Dryden produced in the same metre as "Astræa Redux" the "Annus Mirabilis" (wonderful year), a description of that year 1665 which saw the plague and fire of London and the great Dutch war, including a few fine lines in praise of the new Royal Society; and this piece at once put him above all contemporary poets, except Milton alone. After the death of Sir William Davenant, therefore, Dryden was created poet laureate (1670). It ought perhaps to be mentioned that 1667 not only saw Dryden's "Annus Mirabilis," but Milton's "Paradise Lost," the death of Jeremy Taylor, and the birth of Swift. On the revival of stage plays he engaged to supply the King's Theatre with three plays a year for the annual sum of £300 to £400. The number produced did not amount to more than eighteen in sixteen years. Towards the end of 1671 the Duke of Buckingham's burlesque on heroic dramas, called the "Rehearsal," was produced, Dryden being the original of the caricature of the "author" Bayes; and so happily was Bayes made to parody Dryden's peculiarities of speech, voice, gesture, &c., down to his manner of snuff-taking and the cut of his dress, that the nickname stuck to him through life; and one effect of it was that Dryden exchanged tragedy for comedy. ("Poet Squab" was a later nickname, when obesity had fastened upon him, and was due to the malice of the Earl of Rochester.) A few years afterwards Dryden took leave of rhyme, although a principal part of his "Essay on Dramatic Poesy" is taken up with the defence of rhymed plays. His last rhyming tragedy, "Aurenzebe," was brought out in 1675; but he continued to write for the stage until 1694, producing in all twenty-eight plays.

At length, after having written no verse except for the theatres during about fourteen years, Dryden resumed in 1680 the composition of poetry proper. It is useless to lament what must now be regarded as fourteen years waste of so glorious a genius. Even genius must live, and in the rebound against Puritanism plays, not poems,

were the literary food demanded by the people. (But Dryden need not have descended to imitate the coarseness of Wycherley as he did in his comedies.) All his poems after this date belong to what may be called his third and latest manner, from which all heaviness and languor have disappeared and given place to an animation and fervour, a force, freedom, and fearlessness of execution, in which he is not surpassed by any other English poet.

In 1680 a translation of Ovid's Epistles into English came out, two of which, together with the preface, were by Dryden. In the following year he published "Absalom and Achitophel," a work of first-rate excellence as a political and controversial poem. Dr. Johnson ascribes to it "acrimony of censure, elegance of praise, artful delineation of character, variety and vigour of sentiments, happy turns of language, and pleasing harmony of numbers; and all these raised to such a height as can scarcely be found in any other English composition." In the same year "The Medal," a satire almost without parallel, scathing as Swift, grand as Juvenal, was given to the public. This piece was occasioned by the striking of a medal by the triumphant Whigs on account of the indictment against Lord Shaftesbury being thrown out, and is a severe invective against that celebrated statesman. Both poems had an enormous sale.

In 1682 Dryden published "Religio Laici," in defence of revealed religion against Deists, Catholics, and Presbyterians. Yet soon after the accession of James II. he became a Roman Catholic; and in the hope of promoting popery he was employed on a translation of Maimbourg's "History of the League," an account of the parallel between the troubles of France and those of Great Britain. This extraordinary conversion exposed him to much ridicule from the wits, not altogether ill-deserved; for who would expect a man of fifty-one, whose reputation was made by writing love-plays, to turn to controversial theology?

In the same year appeared his crucifixion of Shadwell—his "MacFlecknoe, or a Satire on the True-Blue Protestant Poet, T.S., by the author of Absalom and Achitophel." Richard Flecknoe was an Irish priest, well known about the court, whose name had become proverbial for his wretched verses; and Shadwell (a man of infamous life who had ventured to lampoon Dryden) is represented as his adopted son, who is to succeed him as monarch of the realm of Dullness and Nonsense.

"MacFlecknoe" was followed by a second part of "Absalom and Achitophel," of which the greater part was written by Nahum Tate; Dryden inserted about 200 lines of his own, in which, exhibiting Shadwell and Elkanah Settle under the names of Og and Doeg, he has laid his scourge on both without mercy. With Settle he had had an old quarrel, in which the Earl of Rochester having been implicated, he had, in 1679, caused Dryden to be attacked and beaten by bravos.

The "Hind and Panther," a controversial poem in defence of the Catholic Church, appeared in 1687. The hind represents the Church of Rome, the panther the Church of England. The absurdity of a fable exhibiting two beasts discoursing on theology was ridiculed in the "City Mouse and Country Mouse," a prose dialogue after the manner of the "Rehearsal," the joint production of Montague, afterwards Earl of Halifax, and Mat Prior, who then put forth the first sample of his talents.

In 1688 Dryden published "Britannia Rediviva," a congratulatory poem, in a high style of adulation, on the birth of the Prince, afterwards known by the title of the Pretender. But even if he had not so identified himself with the ejected dynasty, his conversion to Catholicism disqualified him for holding his place of laureate after the Revolution. It is greatly to Dryden's honour that he remained true to his faith amidst no inconsiderable privations and a species of mild persecution. He was accordingly dispossessed of it; and the mortification of its being conferred on an object of his confirmed dislike aggravated the pecuniary loss, which he could ill afford. His successor was his old enemy Shadwell. In 1693 a translation of Juvenal and Persius appeared. Dryden had now to labour hard at anything that would enable him to live, putting noble work, however, into all that he undertook; and the most laborious of his works, the fine translation of Virgil, was given to the world in 1697. The "Pastorals" were dedicated to Lord Clifford, the "Georgics" to Lord Chesterfield, and the Æneid to Lord Mulgrave—an economical and lucrative combination of flattery which the wits suffered not to pass unnoticed. "Alexander's Feast, an Ode for Saint Cecilia's Day," displays one of the highest flights within the compass of lyric poetry. This, and "Fables" in English verse, from Homer, Ovid, Boccaccio, and Chaucer, were his last work; they were published in 1699. The preface gives a critical account of the authors from whom the "Fables" are translated. In this work he furnished us with the first example of the revival of ancient English writers by modernizing their language. Yet those readers who can master Chaucer's phraseology, and have an ear so practised as to catch the tune of his verse, will like him better in the simplicity of his native garb than in the elaborate splendour of his borrowed costume.

Dryden was a voluminous writer in prose as well as in verse, and quite as great a master of the English language in the former as in the latter. His performances in prose consist of dedications, prefaces, lives, and controversial pieces. The best edition of Dryden's works is in eighteen vols. 8vo, with Life and Notes by Sir Walter Scott; and the best edition of the poems separately is that of Christie, with a dry but very careful memoir (London, 1870).

Dryden died at his house in Gerard Street, Soho, London, 1st May, 1700. He was buried in Westminster Abbey, where a monument was erected to his memory by John Sheffield, duke of Buckingham, founder of a new house of Buckingham which had succeeded to that of his old satirist Villiers.

His body lay "in state" at the College of Physicians, and every person of taste vied in honouring the illustrious departed. So imposing a funeral had never been granted to poet before. Nor were these undeserved honours. For years at Will's Coffee House had Dryden ruled supreme, acknowledged by all the monarch of literature—"a pinch from his snuff-box was a degree in the academy of wit." Johnson says of him, "Perhaps *no nation* ever produced a writer that enriched his language with such a variety of models." With the exception of Shakspeare Dryden is the author best known to Englishmen by quotation and by criticism, and possibly has done more to mould the English language than any other single writer. Dryden founded the heroic couplet, founded satirical poetry, and founded true criticism. He is beyond question, though not our finest poet nor yet our finest prose writer, at once the best prose writer among our poets and the noblest poet among our writers of prose.

DRYING MACHINE, an implement used by dyers, bleachers, calico-printers, &c., for promoting the process of drying by centrifugal action. The wet mass of cloth or yarn is put into a hollow cylinder; this cylinder is made to revolve from 1000 to 2000 times in a minute; the moisture is driven from the cloth with great violence; openings are left to afford an exit for this water into an outer vessel, and in a few seconds the cloth is nearly dry. In some of the baths and washhouses now established, machines of this kind are made to supersede the hard necessity of "wringing" the wet linen.

DRYOBAL'ANOPS, a genus belonging to the order DIPTEROCARPEÆ, and remarkable for the species *Dryobalanops aromatica*, the camphor-tree of Borneo and Sumatra. According to Blume the existence of this camphor-yielding tree was first indicated by Grimm. Kæmpfer was

so well acquainted with its distinctness, that in describing the camphor-tree of Japan he says, "that natural camphor, of crystal-like appearance, which is scarce and of great value, is furnished by a tree of Borneo and Sumatra, which is not of the Laurel genus." Ordinary camphor is derived from a different source, *Cinnamomum camphora*, a native of Japan, China, and Formosa, by heating portions of the plant, thus volatilizing the camphor, condensing it on straws, &c., and afterwards purifying this crude camphor of commerce by distillation. The Borneo camphor, or borneol, is not procured by distillation, but exists in a solid form, as six-sided crystals, in the stem of the tree. In that part of the stem which should be occupied by the pith it is found along with camphor-oil, and on the trunk being split open the camphor is found in the centre, in pieces about a foot long, which is much prized and used in the East, especially in China, but is very rarely sent to Europe. It is mentioned by Marco Polo in the thirteenth century. In this genus Dryobalanops the calyx has a cup-shaped tube, with the limb divided into five leafy erect segments, which are almost equal, whereas in the allied genus Dipterocarpus two of the segments become very much enlarged. There is only one species, a native of the Malay Archipelago.

DU'AL NUMBER. Some languages of the Indo-European stock, as Sanskrit, Greek, Arabic, &c., have three "numbers"—*singular*, marking one object; *dual*, marking two objects; *plural*, marking three or more objects. English in its primitive form (absurdly called Anglo-Saxon oftentimes, as if it were a distinct language) had lost nearly all of its dual forms by the time when it became a written language. Up to 1100 we find the first personal pronouns thus written in English:—

Singular—ic, mín, mé, mé (I, of me, to me, me—acc.)
Dual—wit, uncer, unc, unc (we two, of us two, to us two, us two—acc.)
Plural—wé, úre, ús, ús (we, of us, to us, us—acc.)

So also the second personal pronoun:—

Singular—thú, thín, thé, thé (thou, of thee, &c.)
Dual—git, incer, inc, inc (ye two, of ye two, &c.)
Plural—gé, éower, éow, éow (ye, of ye, &c.)

The dual number began to become uncommon after 1100, and had disappeared by about 1250. Since then English has had but two numbers—singular, marking one; plural, more than one.

English is a form of Low German by origin, and it has, as shown above, been the only Low German tongue to preserve a dual (in its pronouns) down to a literary period. Gothic is, on the other hand, a very early form of High German (whence modern German originates), and this also fortunately has preserved the dual; it is known to us in Ulfilas' translation of the Gospels, and we find it with a dual form of the verb, though not of the noun.

In every case the possession of a dual marks a stage in the language when (as in some of the savage tribes of to-day) the remote ancestors of that nation could only count up to two. The Cape Yorkers of Australia count at the present time as follows:—*Netat*, one; *naes*, two; *naesnatet*, three; *naes naes*, four; and so on. That is to say, they are still in the dual stage; anything beyond this is out of their definite conception. The idea of more than two is so vague as to be inexpressible. Then later the plural forms are added, and as the nation advances the dual wears away, and gets lost either altogether, as in Latin and later English, or almost, as in the early English before 1100. Thus Sanskrit is very full in dual forms both in nouns and verbs, and the reason is that Sanskrit became a dead (*i.e.* a written and not spoken) language early in its development. It is an ancient language which has never become modernized. Greek, a language very early written, by that means preserved many dual inflections, both of verbs and of nouns, but not nearly so truly as Sanskrit; and it is important to note that in Greek the plural may always be used for the dual. When it is said that the Greek duals are not so perfectly preserved as the Sanskrit perhaps the expression will be the clearer for an example. The Greek *anthrôpos* (a man) in common with all other regular Greek nouns has five cases—nominative, genitive, dative, accusative, and vocative, both in singular and plural, though the vocative in nouns is here and there like the nominative. In this case, for instance, though the singular has a separate vocative, the plural, to make a vocative, merely repeats the nominative. But in the *dual* no Greek nouns have more than two forms—one for the nominative, accusative, and vocative; the other for genitive and dative. Thus, in this case of *anthrôpos*, *anthrôpô* means "two men" who do something, "two men" to whom something is done, and "O two men!" while *anthropoin* means "of two men" as well as "by two men." The rest of the dual form has been lost.

The Greek verb, also, with three forms of number—both in singular and plural in the principal tenses (*e.g.* present)—as *luô*, *lueis*, *luei* (I loose, thou loosest, he looses), has but one in the dual, viz. *lueton* (ye two or they two loose—"we two loose" not being expressed); in the historical tenses (*e.g.* aorist) it has two, as *elusaton* (ye two loosed), *elusatén* (they two loosed). Thus in the active. Now in the passive and middle it has two dual forms in the principal tenses (*e.g.* present)—as *luomethon* (we two are loosed) and *luesthon* (ye or they two are loosed); and all three dual forms in the historical tenses (*e.g.* imperfect), as *eluomethon* (we two are loosed or we two loosed for ourselves—the latter being the middle voice); *eluesthon* (ye two, &c.), *eluesthén* (they two, &c.) There is no reason to doubt that originally both in noun and in verb the dual form was throughout as perfect as in this last illustration. It is instructive to note that modern Greek (bearing the same relation to ancient Greek as modern English to the English of Alfred) has altogether abandoned dual forms. Dual forms exist also in Arabic.

The Semitic Hebrew shows a dual in another group of languages; but Hebrew was so long a living language before it became crystallized in literature that the dual has been for the most part worn away, and only remains in nouns.

DU'ALISM, in philosophy, is the name given to the theory that in the universe two orders of mutually independent phenomena can be observed, neither of which can be explained by the laws of the other, as for instance spirit and matter. In religion it is used to describe the belief in the existence of two original beings, one good and the other evil, between whom the universe is divided. Such a belief was the religious faith of Persia from a very remote period, certainly from the time of Zoroaster, and possibly from a time long anterior to his teaching. It formed one of the chief elements in the teaching of the Manichæan sects of the early Christian church.

DUBAR'RY, COUNTESS. See BARRY, COMTESSE DU.

DUB'LIN, a county of Ireland, in the province of Leinster, is bounded N. by Meath, E. by the Irish Sea, S. by Wicklow, and W. by Kildare and Meath. The greatest length, N. and S., is 32 miles; the greatest breadth, E. and W., 18 miles. The area is 354 square miles, or 226,895 acres. The population in 1881 was 418,910.

The county of Dublin, excepting a small tract on the south, is a flat open country highly cultivated. The Dublin Mountains, of which the central group has an average height of 1000 or 1200 feet (Kippure being 2478), are partially separated from the loftier elevations of the county of Wicklow by the valleys of Glencullen and Ballinascorney. The other chief eminences are the Man-of-war Hills, Lambay Isle, Ireland's Eye, and the Hill of Howth (567 feet).

The principal creeks, harbours, and islands of the county

are the following:—Dublin, Killiney, Malahide, Rogerstown, bays or creeks; Lough Shinny and the artificial harbours of Kingstown, Howth, Lambay, and Balbriggan; the island of Lambay, and the islets of Red Island, Colt Island, St. Patrick's Island, Shinnick's Island, Ireland's Eye, and Dalkey. A rocky promontory, on which is a lighthouse, separates Howth Harbour from Dublin Bay. As a harbour the Bay of Dublin is materially encumbered by a great tract of sand, which is bisected by the Liffey, in a direction from west to east, into two portions, called the North and South Bulls. In order to protect it from obstruction by this sandbank, piers and sea-walls have been constructed at a great expense, and a constant outlay is required for repairing and dredging. The bay stretches across from Howth to Dalkey, about 6¾ miles, and extends semicircularly inland about 6. On account of the imperfections of this bay, a noble harbour has been formed at Kingstown, on the site of the old harbour of Dunleary, a little southward of Dublin Bay.

The Liffey has a course of little more than 8 miles from the point where it enters Dublin County to the Bay of Dublin at Ringsend. It is navigable for vessels of 1200 tons to the custom-house, and for barges and row-boats to Chapel Izod, about 2 miles further up. The Dodder and the Tolka are the other chief rivers of the county. The Royal Canal, 94 miles long, and capacious enough for boats of 100 tons burden, extends from Dublin to the Upper Shannon, in the county of Longford. The Grand Canal, about 95 miles long, and rather more capacious than the Royal, extends from Dublin across the Shannon to Ballinasloe. At the Dublin end there is an extensive range of docks. The county is well supplied with railway accommodation.

The climate of Dublin is temperate; frosts rarely continue more than a few days, and snow seldom lies long. The prevailing winds are from the south-west.

The greater part of the county of Dublin is occupied by a tract of mountain limestone, being a part of the central limestone field of Ireland. Along the northern coast there are patches of primitive rock, as greenstone, argillaceous schists, and stratified quartz. The primitive formation on the south of the limestone plain consists of a ridge of granite supporting flanks of micaceous and argillaceous schists. The limestone is much used for building. A little lead, manganese, fullers' earth, and potters' clay are found. There are mineral springs in great abundance.

The vegetable soil of the county of Dublin is generally shallow. On the granite bottom it is a light gravel, which requires strong manuring. There is but a small portion of the county under tillage. Villas, gardens, dairy farms, kitchen gardens, and nurseries occupy the immediate neighbourhood of the capital, and grazing farms and meadow lands extend over the country which is not occupied by demesnes.

Dublin is a manufacturing rather than an agricultural county—more than a third of the families it contained in 1881 being returned as chiefly employed in trades and manufactures, and less than a thirteenth in agriculture alone. The trades are, however, chiefly such as are needful for local requirements. The chief are some extensive stout and porter breweries at Dublin, whisky distilleries, and hosiery works at Balbriggan. There are also some very large corn-mills in different parts of the county, and limestone and granite are extensively quarried. The fisheries off the coast, which had declined, are improving, especially the herring fishery of Howth.

The county is divided into nine baronies, and contains seventy-six civil parishes and ten parts of parishes, and 1066 town-lands. It returns two members to Parliament, and two are returned for the city of Dublin.

History and Antiquities.—The civil history of the county of Dublin is immediately connected with that of the capital. The pagan antiquities are not numerous; they consist mainly of three cromlechs. Dublin is, however, rich in ecclesiastical and military antiquities. The round tower of Clondalkin, 4½ miles from Dublin, is in better preservation than most other similar edifices in Ireland. The antiquities at Swords, 8 miles from Dublin, consist of a palace of the archbishops of Dublin, in ruins; a square steeple of the old church; and a round tower, 73 feet in height. At Lusk there is an ancient church with a square steeple, attached to three of the angles of which are round towers with graduated parapets, and at the remaining angle a round tower of greater altitude and superior construction, supposed to be the original building. Between Swords and Baldoyle, 5 miles from the capital, is the hamlet of St. Doulagh's, containing one of the most singular stone-roofed churches in Ireland. This church has been recently restored. In the vicinity of Howth Castle are the ruins of St. Fintan's Church, and of the collegiate church and abbey of Howth. There are some interesting remains of antiquity at Dalkey, Clontarf, Baldongan, Naul, and Castleknock.

DUB'LIN, a county of a city, municipal and parliamentary borough, port, and the metropolis of Ireland, is situated on both sides of the river Liffey, at its entrance into the Bay of Dublin, 292 miles W.N.W. from London, 138 miles W. by S. from Liverpool, and 63 miles W. from Holyhead. Besides the Liffey, Dublin is watered by the Dodder, the Tolka, and the Slade.

Dublin is supposed to be the *Eblana* of Ptolemy, and was called by the native Irish *Ballyath-cliath*, "the town on the ford of hurdles;" and by the Danes *Divelin* or *Dubhlin*, "the black pool," from its vicinity to the muddy swamps at the mouth of the river. At the period of the English invasion under Strongbow, in 1169, the city was of very limited extent; its buildings being confined to the summit and declivities of a hill on the south side of the Liffey, and inclosed by a wall little more than a mile in circuit. For many years afterwards its increase in extent and population was extremely slow. At the commencement of the seventeenth century its suburbs extended but a very short distance beyond its ancient walls. In the wars of 1641 the additional works thrown up for the defence of the place lay between the castle and the college, which was then considered as outside the city. After the revolution the progress of improvement was comparatively rapid; new lines of streets were opened, particularly to the north and east; many of the confined old avenues were enlarged; several squares were laid out, and the buildings, both public and private, were constructed with greater regard to architectural elegance as well as internal convenience. Dublin was several times in the possession of the Danes in the ninth, tenth, and eleventh centuries. In 1169 it was taken by storm by the English, under Richard de Clare, better known by the name of Strongbow. The Danes two years afterwards laid siege to it with a numerous naval and land armament, but were defeated with the loss of their leader, and forced to raise the siege. This was their last attempt to recover the dominions they once held in Ireland. In 1172 Henry II. landed, and held his court here in a temporary building erected outside the town, which was too small to afford suitable accommodation for the monarch and his retinue. In 1205 the castle was erected, and four years after the citizens were unexpectedly attacked while amusing themselves in Cullen's Wood, now a suburb, by a party of Irish from the Wicklow Mountains, and forced to seek the protection of the fortifications after the loss of many lives. In 1210 King John held his court in Dublin, and about the same time the first bridge was built across the Liffey. In 1316 Edward Bruce was repulsed in an attempt to take Dublin. It was twice visited by Richard II., who took his final departure from it in 1399, the year of his dethronement and death. In 1486

the citizens declared for Lambert Simnel, and crowned him in Christ Church. In 1538 Lord Thomas Fitzgerald, having rebelled against Henry VIII., laid siege to the city, on which occasion his batteries were mounted at Preston's Inn, now almost in its centre; but the obstinate resistance of the citizens, who burned great part of the south-west suburb to check his approach, compelled him to raise the siege. In 1583 a dispute between two of the Irish family of O'Connor was decided by wager of battle in the castle before the lords justices and council. About the same time the king's exchequer, which was kept between College Green and the Castle, was plundered by a party of Irish from the mountains. During the civil wars of 1641 the battle of Rathmines, in which the Duke of Ormond was totally defeated by the garrison of Dublin, was fought in the neighbourhood. The Grand Canal was commenced in 1765. In 1778 the first regiment of Dublin volunteers, arrayed for the defence of the kingdom against the threatened invasion by the French, appeared under arms. Since then it has been the scene of many alarms from Fenians and others. The city is now 3 miles long from north to south, and 2½ broad from east to west. The population increased from 246,326 in 1871 to 348,525 in 1881.

Dublin was formerly said to be surrounded by the Circular Road, 9 miles in extent, but it has long outgrown that limit. The Liffey is crossed by eleven bridges, seven of which are of stone and four of iron, and is embanked on each side along the whole range of the city by quays faced with granite. The length of the bridges varies from 140 to 258 feet.

The ground on which Dublin stands rises gently from the river towards the north and south-west. The eastern division on the south of the river lies almost wholly without the limits of the ancient city, on level ground, the northern part of which has in a great measure been reclaimed from the former bed of the Liffey. The whole area of College Green, on the east, is occupied by the front of Trinity College, a rich and dignified pile of building of the Corinthian order, built in 1759, and extending north and south 300 feet. Adjoining it is Trinity College Park, the area of which is about 20 acres. Here also is the Bank of Ireland, considered the finest building in Dublin. It was formerly the Irish House of Parliament.

In this district of the city are situated the principal banks, insurance and other offices. The Banking business is carried on by the Bank of Ireland, Hibernian, Provincial, National, Royal, Ulster, Leinster, and Munster Banks. Many of the banks and insurance offices are handsome buildings, as is also the City Hall, Cork Hill. The Castle of Dublin, with the old round tower and Chapel Royal, are ancient buildings, consisting of two handsome quadrangles, surrounded, except on one side, by the apartments of state and various government offices. South-west of the Castle is the oldest part of the city, now almost exclusively occupied by small dealers and the labouring classes, in the midst of which stands Christ Church Cathedral, a cruciform structure of early date restored by Henry Roe, Esq., J.P., in 1874 and 1875. St. Patrick's Cathedral, south from Christ Church, is an imposing pile, consisting of nave and transepts, choir, and chapter-house. It was restored by the munificence of the late Sir Benjamin Lee Guinness at a cost of £150,000. Adjoining this division of the city are Portobello Barracks, Richmond Prison, from which James Stephens, the Fenian head-centre, escaped on the 24th November, 1865; The South Dublin Union Workhouse, Richmond Barracks, Royal Hospital Kilmainham (for army pensioners), Kilmainham Gaol and the County Court-house, Island Bridge Barracks, Steven's and other hospitals. In the northern division are situated the new cattle market and abattoir, Glasnevin Cemetery, in which are erected monuments to O'Connell and other distinguished Irishmen, and Mountjoy Convict Prison.

The eastern division of the city lying north of the Liffey occupies higher ground, and is the airiest part of Dublin. The custom-house occupies a detached plot of ground on the quay leading from O'Connell Bridge to the north wall. To the east are docks and stores, which are on a very extensive scale, surrounded by a lofty wall. Near the middle of Sackville Street stands a fluted Doric column, on a pedestal of large proportions, surmounted by a colossal statue of Lord Nelson. In 1876 a marble statue by Farrell of the late Sir John Gray was erected in Sackville Street, and in 1882 a statue of O'Connell. West of Nelson's Monument the General Post Office presents a cut granite front of 223 feet to the street, with a central Ionic portico of Portland stone. In 1870 a marble statue of William Smith O'Brien, by Farrell, was erected on the south side of O'Connell Bridge, at the junction of Westmoreland and D'Olier Streets.

The western division of the city north of the river is not intersected by any street of large proportions, and is almost exclusively occupied by dealers, tradesmen, and labourers. The portion of it which lies along the quays and towards the Blue-coat Hospital is, however, well built and respectably inhabited. The Four Courts, situated on King's Inn Quay, in this district, was opened in 1796, and is a building of great extent and splendour, and has been lately largely added to. To the rear of the Four Courts is a court-house, in which the police magistrates daily preside to dispose of summary cases. Westward from the courts of law the Royal Barracks occupy an elevated site. On the outskirts of this division of the city, north-east from the Royal Barracks are—the Blue-coat Hospital, founded in 1773; the Richmond Lunatic Asylum, North Dublin Union Workhouse and hospitals attached, the Linen Hall, and the King's Inns. West of the Royal Barracks is the Phœnix Park, so sadly famous as the scene of the murder of Lord F. Cavendish and Mr. Burke in 1882—a finely wooded demesne of 1753 acres, containing the vice-regal lodge and lodges of the secretaries, the Zoological Society's gardens and establishment, the Royal Military Infirmary, the Hibernian Society's School for the education of the children of soldiers, a powder-magazine and Royal Engineers' Barracks, a constabulary depot, a grand obelisk erected in commemoration of the victories of the Duke of Wellington, a fine equestrian statue by Foley of Lord Gough, cast from metal of guns captured in India by the troops under his command, and a bronze statue of the Earl of Carlisle.

Besides the two cathedrals the city contains numerous parish and other churches. In addition to the Roman Catholic cathedral th re are also about eleven Roman Catholic parochial churches, and several friaries, monasteries, and convents. There are also places of worship for sects of various denominations. Of educational institutions there are, besides Trinity College, the Royal Dublin Society, the Royal Irish Academy, the Royal Hibernian Academy of Painting, Sculpture, and Architecture; the National Education Society, Kildare Place Society, the Dublin Society, and others.

The principal places of recreation are—the Gaiety Theatre, the Queen's Theatre, the Botanic Gardens at Glasnevin, the People's Gardens in the Phœnix Park, the Zoological Gardens, Phœnix Park, and St. Stephen's Green, opened as a public park by the munificence of Lord Ardilaun in 1880; the Museum of the Royal Dublin Society and National Picture Gallery of Ireland, Leinster House, Merrion Square.

The hospitals, dispensaries, and similar charitable institutions in Dublin are very numerous.

The Kingstown and Dublin Railway connects several places by a coast line with the city. The Dublin and Wicklow Railway connects Dublin with Wicklow, Enniscorthy, and Wexford; and the Great Northern Railway with the Northern Counties. The Great Southern and Western

runs to Cork, and the Midland Great Western to Galway and the west of Ireland.

The Royal and Grand Canals, on the north and south, form channels of commercial communication with the interior of the country to the Shannon. An ample supply of water is brought into the city from the river Vartry, 17 miles distant; and in 1875 an extensive scheme of drainage was undertaken which has greatly improved the sanitary state of the city.

The corporation consists of the lord mayor, chosen annually from among the aldermen or town councillors, fifteen aldermen, and forty-five town councillors.

The supply of fuel is almost wholly by colliers from the opposite coast of England, especially Whitehaven. Turf for lighting fires, &c., is furnished from the extensive bogs of Kildare, Queen's County, and Westmeath, by the boats of the Grand Canal and Royal Canal. Brewing, especially of stout and porter, iron-casting, and cabinetmaking are the principal manufactures in a prosperous state. Shipbuilding is also on the increase, and two extensive sugar-refining factories have been established. There are wholesale markets for hay, bacon, butter, potatoes, fish, &c.

The Chamber of Commerce was established in 1820. The commerce of the port of Dublin had increased so much towards the close of the last century, that the accommodation afforded in the river for shipping was found insufficient, and Parliament consequently granted £45,000 for forming docks on both sides of it. The docks communicating with the Grand Canal on the south side were opened in 1796, and St. George's, the latest of the custom-house docks, in 1821. These latter cover an area of 8 acres, have 16 feet depth of water and 1200 yards of quayage, and are capable of accommodating 40,000 tons of shipping. Some further improvements have recently been made in the harbour, in order to increase the accommodation for larger vessels, and new graving docks constructed. The Midland Railway Company have executed some great works in order to bring the shipping of the port into direct connection with the railway system of the country. The works embrace a new shipping dock at the North Wall, the improvement and extension of the dock for the canal boats at the end of the canal, the changing of the principal bridges over the canal and railway, and the erection of new locks in the canal. The dock gives to ships a quayage of 1710 feet long by 100 feet wide, with a depth of water of 15 feet. The lock entrance will admit a ship or steamer of 178 feet long, 25 feet beam, and drawing 15 feet of water. The old dock, affording 830 feet quayage, has been cleaned out. The swivel bridge and entrance gates to the upper and lower docks will let in any vessel or steamer that can pass through the sea entrance of the Liffey, and in this way all the ordinary cross-channel steamers can pass direct from the sea to the docks, and there transfer their goods to the railway or the canal boats for immediate carriage through the country. On the east side, near the bridge of the Drogheda Railway spanning the canal, the Midland Company have constructed means by which ships can be lifted to have their bottoms repaired. The trade of the port has very much increased of late years. The exports are chiefly porter, whisky, cattle, and butter.

The number of vessels registered as belonging to the port in 1884 was 500 (60,000 tons). The entries and clearances average 8000 (2,200,000 tons) per annum. The customs duty in 1888 amounted to £800,000.

The parliamentary borough returns four members to the House of Commons.

The University of Dublin is incorporated as "the College of the Holy and Undivided Trinity near Dublin, founded by the most serene Queen Elizabeth." The collegiate body consists of a provost, seven senior fellows, one of whom is vice-provost, twenty-six junior fellows, and seventy scholars. A medical school has been long attached to the university, to which has lately been added a school of civil engineering; and degrees and licenses in surgery and civil engineering are granted by the board on the completion of the prescribed courses. The college possesses a fine library of about 140,000 printed volumes and 1500 manuscripts, and the number is increased annually by about 1500 volumes, which are partly purchased and partly obtained under the Copyright Act; it has also a well-stocked botanic garden and a museum.

In 1873 an Act was passed by which all religious tests were abolished, and the benefits of the college were thrown open to persons of every denomination. More fully to give effect to this Act, a queen's letter was obtained in 1874 authorizing the establishment of a representative council of the university with consultative functions.

The Royal University of Ireland.—By Her Majesty's letters patent, bearing date the 27th April, 1880, a university was founded in pursuance of the provisions of the University Education (Ireland) Act, 1879, under the style and title of "The Royal University of Ireland," which has since 3rd February, 1882, superseded "The Queen's University in Ireland," it being provided that the graduates and students of the latter university shall have similar rank in the new university. The newly established university corporation consists of a chancellor (Earl Dufferin, elected 30th July, 1886), a senate, and graduates. The government of the university is vested in a senate consisting of the chancellor and senators—the senators not to exceed thirty-six in number—with power to grant all such degrees or other distinctions as can be conferred by any university of the United Kingdom, except in theology. The charter gives power to confer such degrees upon all male or female students who shall have matriculated in the university and passed the requisite examinations prescribed by the senate; and provides that no residence in any college, nor attendance at lectures, or any other course of instruction in the university, shall be obligatory upon any candidate for a degree other than a degree in medicine or surgery. These privileges are the same as those hitherto in force in the London University. The first meeting of the senate was held on 24th June, 1880. Lord Emly was elected vice-chancellor of the university 8th April, 1885. The university buildings are situated in Earlsfort Terrace. The Act 44 & 45 Vict. c. 52, provides for the payment of £200,000 a year out of the surplus funds of the Irish Church for the purposes of the university.

Roman Catholic University of Ireland.—The synod of the Roman Catholic prelates, which was held at Thurles in 1850, determined to establish a university, and appointed a committee, consisting of the four archbishops, four suffragan bishops, eight other ecclesiastics, and eight laymen, to collect funds and make other necessary preliminary arrangements. The synodal meeting held at Dublin in May, 1854, formally established the university. The schools were opened on 3rd November, 1854. The Roman Catholic University has no endowment or settled property, and depends for its maintenance wholly upon the voluntary contributions of the Roman Catholic people of Ireland.

The university church, the library, and the mineralogical and natural history cabinets, and the principal lecture halls and central offices are situated in Stephen's Green. The school of medicine, with its museum and chemical laboratory, are situated in Cecilia Street.

In September and October, 1882, the Roman Catholic bishops resolved, while maintaining the Catholic University as a national institution, to place the buildings in Stephen's Green and Cecilia Street under the control and direction of the Catholic Archbishop of Dublin, who undertook to maintain a college in which an arts and medical education would be given according to the regulations of the Royal University.

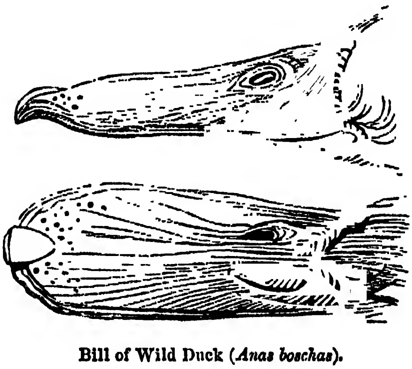
DUC'AT, the chief coin of a dukedom (Lat. *ducatus*); but the ducats of Venice were generally called *zecchini* (sequins), *zecca* being the well-known Venetian Mint. The word takes its origin, indeed, not from the Doge of Venice, as was sometimes thought, but from the Duke of Apulia. This prince struck gold coins for Southern Italy and Sicily in 1140, bearing the Latin legend, "Sit tibi, Christe, datus quem tu regis—iste ducatus" (To thee, O Christ, be given that which thou rulest—this duchy); whence *ducatus* or ducat came to be the name of the coin. Venice followed suit with the zecchino, containing 54 grains Troy of pure gold, like the florin of Cyprus and the imperial German ducat. A smaller piece, called a ducat, was long afterwards introduced at Venice, and is still to be found occasionally, worth about 6*s.* Sicily, under King Robert, also, in 1240, adopted a silver ducat of about 3*s.* 6*d.* or less, present value, not yet entirely extinct; and the empire of Germany in 1559 formally adopted the ducat of 54 grains Troy as its gold standard. The German ducat lasted into the memory of the last generation, worth 9*s.* 4*d.* The silver *ducado* of Spain still exists, but is better known by the name of dollar (hard-dollar), and is now worth 4*s.* 2*d.*

DUCK is a very comprehensive term, embracing the greater part of the Anatidæ, one of the largest families of ANSERES or swimming birds. This large family, however, may be divided into several subfamilies, and it is with one of these divisions, the Anatinæ or Fresh-water Ducks, and more particularly with the domestic species and its wild original, that we will deal in this article. The characters common to all the Anatinæ are given by Mr. Yarrell as follows:—"Externally they exhibit considerable length of neck; the wings are also long, reaching to the end of the tail; the tarsi somewhat round; the hind toe free, and having no pendent lobe. In habits they may be stated generally as frequenting fresh water, but passing much of their time on land, feeding in ditches and about the shallow edges of pools on aquatic plants, insects, worms, and occasionally fish, taking their food at or near the surface; possessing great powers of flight, but seldom diving unless pursued. Of their internal soft parts, the stomach is in the greatest degree muscular, forming a true gizzard; the intestines long; the cæcal appendages from 6 to 9 inches in length in the larger birds, and decreasing only in proportion to the size of the species. Of the bones it may be observed that the ribs are short, extending but little beyond the line of the posterior edge of the sternum; the keel of the breastbone deep, affording great extent of surface for the insertion of large and powerful pectoral muscles. The osseous enlargement (or drum) at the bottom of the trachea (within the body) is in all of them composed of one bone only. The wild duck may be considered the type of this division."

The beak of the duck, armed with a nail or dertrum at its tip, is at once a feeler, a strainer, and an organ of prehension. It is highly sensitive, and feels out food in the mud, where it is used with singular address. The skin, or coriaceous membrane covering the bone, especially along the margins of the mandibles, is freely supplied by branches of the fifth pair of nerves, which endow it with a discriminating sensibility. The edges of the mandibles are furnished with close-set transverse plates (*lamellæ*) to enable the mud and water taken up with the food to be strained away. In accordance with the sensibility and structure of the beak is the tongue modified. It is also a sensitive organ, and instead of being slender and horny is large and fleshy, and furnished on its margin and other parts with fimbriations or appendages. The tongue, in fact, in the Anatinæ co-operates with the mandibles in the discrimination and appropriation of food.

The Anatinæ are universally distributed, and many species are common alike to Europe, Asia, Africa, and America. Most are migratory in their habits, reaching in the winter as far south as Egypt, India, and Central America, and in the summer to Siberia, Lapland, Iceland, Greenland, and the extreme north of America. The flocks during their migration assume definite figures, as lines or triangles, the leader giving place to others in succession. The males usually differ much from the females in plumage during the breeding season, but towards the close of the summer they lose more or less their distinctive livery, reacquiring it on the moult next ensuing. Most breed amidst the herbage of marshes, or along the borders of lakes or sheets of water.

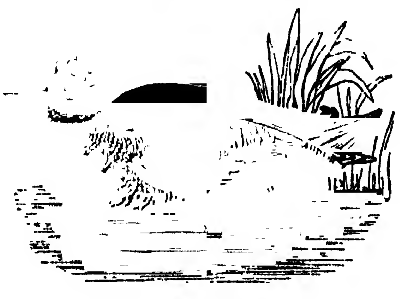
The Wild Duck (*Anas boschas*), of which the male is known as the mallard (instead of drake, which is applied to the males of all other ducks), is an abundant species in this country, and was formerly much more numerous here before the fens and marshes were so generally drained. A few pairs remain here through the summer; but the majority resort to high northern latitudes to breed, and visit us in large flocks at the approach of winter. The wild duck frequents marshy places and the borders of rivers and lakes, where it finds an abundant supply of nourishment in the form of worms, insects, and mollusca, except in very severe winters, when it is forced to resort to estuaries in search of food and open water. The mallard loses in a great measure his distinctive markings towards the end of summer, acquiring a plumage not very different from that of the female, which he retains till the general moult. As the flesh of the wild duck is exceedingly good, it is captured in great quantities during the winter season, sometimes by means of the gun, and sometimes by peculiar traps known as decoys. These consist of long-curved canals, leading out of a piece of water much frequented by water-fowl, and covered with nets supported upon hoops. The birds are enticed or driven into these canals by means of decoy ducks, trained to come to a whistle, and assisted by equally well-trained spaniels. The fowlers are concealed by means of reed-screens, so disposed that they may be seen by the birds which have advanced beyond them into the decoy, and which are thus caused to give up all thoughts of retreat; they consequently push forward to avoid the dog and his master, until they reach the termination of the canal, which gradually grows narrower, and ends in what is called a tunnel net capable of being detached from the main net of the decoy as soon as it is filled with birds. These are then taken out and killed by the fowlers.



Bill of Wild Duck (*Anas boschas*).

There seems no doubt that all the domestic varieties are descended from this species. The males of all the domestic breeds have the four middle tail-feathers curled upwards, which is a distinctive character of *Anas boschas*. In addition all the breeds are fertile together and with the wild species, and there is a tendency in all of them to revert to the plumage of the wild species. A curious result of

domestication is that whereas the wild ducks always pair, the domestic breeds, as is well known, are polygamous. The domestication of the duck is comparatively recent, later than Homeric times (when the goose was domesticated), and probably not much earlier than the beginning of the Christian era. Darwin recognizes four distinct breeds. The first is the common domestic duck, with several sub-breeds, as the Aylesbury, the Rouen, the Tufted Duck, with a large top-knot of fine downy feathers, and the Labrador (or Buenos Ayres), in which the plumage is entirely black. The second breed is the Hook-billed Duck, in which the bill is strongly curved downward. The Call Duck is very small, and the females, from their remarkable loquacity, are of great service as decoys. The Penguin



Wild Duck (*Anas boschas*).

Duck "is the most remarkable of all the breeds, and seems to have originated in the Malayan Archipelago. It walks with its body extremely erect, and with its thin neck stretched out."

The limits of the genus Anas are somewhat indefinite. The following species are considered by some as belonging to it, but by others are made types of distinct genera:—GADWALL, PINTAIL, SHOVELLER, TEAL, WIDGEON. Besides these the following, belonging to the subfamily Anatinæ, will be noticed separately:—MUSK DUCK, SHELDRAKE, SUMMER DUCK, TREE DUCK. The remaining subfamilies of the Anatidæ are the Anserinæ (GOOSE), Cygninæ (SWAN), FULIGULINÆ (Sea Ducks), ERISMATURINÆ (Spiny-tailed Ducks), and Merginæ (MERGANSER).

DUCK'BILL, DUCK-MOLE, or WATER-MOLE are the various names given to one of the most extraordinary animals existing, *Ornithorhynchus paradoxus* (or *anatinus*). This animal, with the genus ECHIDNA, makes up the order MONOTREMATA, the lowest and most primitive section of the MAMMALIA. The duckbill, as the name implies, has a horny beak resembling that of a duck. This beak is broad and compressed, and bordered by a naked, sensitive, membranous integument. The lower jaw is shorter and narrower than the upper, and is marked by transverse ridges, as in the bill of ducks, the object being the same in both cases—namely, to enable the animal to strain away the mud and water it has taken up with its food. No true teeth are present in the jaws. Their place is supplied functionally by eight horny structures, regularly disposed, two on either side above and below; the front teeth are long, narrow, and sharp, the others are broad and molar-like. The tongue is not extensile; the anterior half or narrow portion is covered with coarse papillæ, while the posterior division is broad, slightly overlapping the former, and armed in front by two prominent horny spines. The mouth is provided with cheek-pouches. According to Professor Owen, "the raised posterior lobe of the tongue must impede the passage of unmasticated food to the pharynx, and doubtless tends to direct it on each side into the cheek-pouches, whence the Ornithorhynchus may transfer its store at leisure to the molar teeth, and complete its preparation for deglutition. An air-breathing, warm-blooded animal, which obtains its food by the capture of small aquatic animals while submerged, must derive great advantage from the structure which enables it to transfer them quickly to a temporary receptacle, whence they may be extracted and masticated while the animal is floating on the surface or at rest in its burrow."

The eyes are very small. The legs are short and fitted for swimming. The feet have five toes, armed with large claws, and are webbed, the web extending in the fore feet between and beyond the claws. In the hind feet of the males there is a short spur on the heel in connection with a gland; this spur has probably a sexual character. The hemispheres of the brain are smooth. The tail is flattened, broad, and conspicuous. The fur is close and hairy, tawny or reddish-brown in colour. In the young state the skin is entirely destitute of hair, and the paws are short, soft, and flexible. The water-mole is entirely confined to Australia and Tasmania. It is about 18 inches long. It feeds on small molluscous animals, various aquatic larvæ, and especially on water-bugs belonging to the genus Naucoris, which abound in the running streams and lakes of Australia. The most interesting account of the habits of this animal yet placed on record is that given by Mr. Bennett in the first volume of the *Zoological Society's Transactions*. Speaking of one which he kept in a semi-captive state, occasionally tethering it to a stake by the river's side, he tells us that "it was exceedingly lively, swam in the centre of the stream, and appeared in excellent health and spirits. The water at one part of the river being very clear, I saw its movements distinctly under the water. On diving it sank speedily to the bottom, swam there for a short distance, and then rose again to the surface; it ranged the banks, guiding itself in its progress according to the impressions received by the mandibles, which appeared to me to be used by it as very delicate organs of touch. It seemed to feed well; for whenever it inserted its beak into the mud it evidently procured some

Duckbill.

food from thence, as, on raising the head, after withdrawing the beak, the mandibles were seen in lateral motion, as is usual when the animal masticates. Although several insects were basking and fluttering about the surface of the water close to it, no attempt was made to capture them, either from its not seeing them, or from its preferring the food which the mud afforded. The motions of the mandibles in this animal, when seeking its food in the mud and water, are the same as those of a duck when feeding in similar situations. After feeding it would lie sometimes on the grassy bank, and at others partly in and partly out of the water, combing and cleaning its coat as usual with the claws of the hind feet."

The water-mole constructs burrows of great length, usually from 20 to 30 feet, and sometimes attaining a length of 50 feet. A burrow described by Mr. Bennett

commenced in some long grass about 5 feet from the water's edge passed upwards in a serpentine direction, terminating near the surface of the ground in a rounded excavation, the lower part of this hollow forming a nest of dried grass and weeds.

DUCT, a short tube by which a secreting organ discharges its secretion, such as the *hepatic duct*, which conveys the bile and pancreatic juice from the liver and the pancreas to the intestine during digestion, and the *cystic duct*, which conveys the bile to the gall-bladder when digestion is not going on. The *thoracic duct*, however, which conveys the chyle from the lacteals of the intestines and the lymphatics to the left shoulder, where it is poured into the blood, is a tube of some considerable length, for it runs the whole length of the spine. The chyle flows upwards, and that without the propulsion of the heart, in the same way as the sap flows in a tree, *i.e.* by *vis a tergo*, through the pressure of the continued absorption behind.

DUD'LEY, a market-town and municipal and parliamentary borough of England, in the county of, and 26 miles N. by E. from Worcester, 8½ W.N.W. of Birmingham, and 121 from London, with which it communicates by both the Great Western and the Midland Railways, is situated in an isolated part of the county, surrounded by Staffordshire. The extensive remains of Dudley Castle form a very interesting object on a height in the neighbourhood, and are a striking contrast to the scene of activity and bustle beneath. The castle was founded in the year 700 by a Saxon chief named Dudo, from whom Dudley seems to be named, and was rebuilt in the reign of Henry II. It withstood a three weeks' siege by the Parliamentary forces during the Civil War in the reign of Charles I., but was ultimately demolished. It was again rebuilt, and burnt down in 1750. Near the town are also the remains of a priory built in 1155. There are numerous churches and chapels; a grammar-school founded in 1638, of which Richard Baxter, the celebrated nonconformist divine, was for some time master; a court-house, &c. The Guest Hospital, for which Mr. Guest left £20,000, was built in 1872 by the Earl and Countess of Dudley at a cost of over £30,000. St. Thomas' Church, built at a cost of £23,000, is a fine Gothic structure with a lofty and conspicuous spire. The museum of the Geological Society contains numerous specimens of interesting fossils and minerals collected in the neighbourhood. Fossiliferous limestone abounds here, and is manufactured into beautiful ornamental articles. The immense caverns wrought into the limestone are very remarkable, and particularly interesting to the geologist. The principal trade of the town consists in the smelting and working of iron ore, with which the whole neighbourhood abounds, as well as with coal and limestone. Dudley lies in the very heart of what is known as the Black Country, and presents by night, as well as by day, one of the most remarkable scenes of ceaseless industry which England can show. The country for miles around is covered with the bank fires of coal pits, blast furnaces, forges, and iron-mills. The nail-making is very extensive, 2000 workpeople being engaged on horse and mule shoe nails alone. Enormous numbers of anvils and vices are made, both for home use and for the United States, where they are held in higher repute than any other. The leading firm makes about 10,000 anvils and as many vices every year. Steam hammers of many tons' weight are employed in the manufacture of large ships' cables, anchors, and heavy forgings of all kinds. Fire-irons, stoves, fenders, edge-tools, files, scythes, agricultural implements, and gasometers, &c., are also made; and there are, besides, brass-foundries and glass-works. The chief land-owner is the Earl of Dudley, who is the largest iron-master in the kingdom. One of his numerous gifts to the town is the handsome drinking fountain erected in the market-place in 1867, at a cost of £3000. The singularly picturesque grounds of Castle Hill, embracing the curious limestone caverns, have been laid out and presented to the town by the earl. A very fine building of Italian character was in 1864 erected at his cost for the use of the mechanics' institute. He also built in 1861 an asylum for the blind, a pleasant structure standing in 3 acres of pleasure grounds in Tipton Road. The parliamentary borough returns one member: population in 1881, 87,527; number of electors, 15,000. The population of the municipal borough is only 46,252. The municipality consists of ten aldermen, including the mayor, and thirty councillors. At Saltwell, near Dudley, is an excellent spa, and near it are chalybeate springs.

DUEL, a premeditated combat between two persons for the purpose of deciding some private quarrel. It is in fact a survival of the ancient practice of trial by ordeal of battle. This is said to have been introduced into Europe by Gondebald, king of the Burgundians, in 501. Louis le Débonnaire was the first of the French kings who allowed litigants to decide their disputes by force of arms. The judicial duel subsequently became a very widely spread custom throughout Europe, and though women, children, and ecclesiastics were exempt from personal appearance they were required to appear by proxy. It was introduced into England by William the Conqueror, and it formed part of English law until 1818, when it was abolished by a special Act of Parliament (59 Geo. III. c. 46). See APPEAL.

Duels were not common before the sixteenth century, but once fairly introduced the practice spread to an enormous extent, though many laws were passed for its suppression. Among the nations of Europe France has always maintained the pre-eminence in the matter of duelling, and during the latter part of the sixteenth century and the commencement of the seventeenth the practice there became almost a mania. A historian of the period records that in the eight years between 1601 and 1609, 2000 men of noble birth fell in duels. In 1609 the custom received a check from the passing of a severe edict imposing penalties of the severest description upon all who should fight without royal permission, and from the institution of a court of honour to deal with the quarrels of officers and of private gentlemen. In the reign of Louis XIII. the rage for duels revived, and it became the fashion for seconds as well as principals to engage in the conflict, while many were fought merely to acquire the fame of a successful duellist. The English ambassador at the French court, writing home at this period, declared there was scarcely a Frenchman worth looking on who had not killed his man in a duel. In 1679, however, the practice received a decisive check by the issue of an edict which imposed very heavy penalties upon all who took part in a duel, which penalties were inflicted by the king without mercy. At the same time the chief noblemen of France entered into a solemn agreement with each other that they would never engage in a duel on any pretence whatever. After the Revolution the custom was revived to a certain extent, and it still maintains its ground among military officers, politicians, and Parisian journalists. In the German army duelling is still winked at. Nominally forbidden to fight a duel, an officer would at once be cashiered if he refused. What is still more insensate is that the youths at the universities carry the duel to an incredible extent. Few youths of spirit are without cuts on the face from the clumsy sabres with which they fight. At Jena in March, 1883, twenty-one duels were fought in one day among the students; and this leading to inquiry it was found that at the same time forty young men were lying in the hospital in a serious condition from wounds from ill-cleaned arms.

In England though the duel was never so much in fashion as in France, it was yet very common during the reign of Elizabeth and James I., and it became also exceedingly prevalent during the reign of Charles II. Duels became less common after this period, but the practice never wholly fell into disuse until the middle of the present century, a fatal

duel having been fought between two British officers in 1848. This event led to an important amendment in the Articles of War, by which the sending or accepting of a challenge was made an offence, rendering the offender liable to be cashiered by court-martial. Penalties were also imposed upon officers who should be privy to an intention to fight a duel without doing all in their power to prevent it, while approbation is given to those who, having had the misfortune to give offence, shall explain, apologize, or offer redress, and to those who readily accept such apology or explanation. In cases where such an adjustment is not possible the matter is to be submitted to the arbitration of the commanding officer.

By English law the killing of a person in a duel is murder under any circumstances; and it is deemed murder in the seconds as well as in the principals, so that even the second of the party killed may be indicted and convicted of murder, as being present aiding and abetting. Sending a challenge, either by word or letter, to a person to fight a duel is a misdemeanour punishable with fine or imprisonment or both.

DUET' (from the Ital. *duetto*, the diminutive of *duo*) is a composition for two equal performers, vocal or instrumental. A song or solo with a pianoforte accompaniment is not a duet, since one of the parts is mere accompaniment, and so subordinate; but a pianoforte piece for four hands is rightly called a duet, because though one part may sometimes be simpler than the other, both are indispensable. Extended compositions for two parts are usually called *duo* or *grand duo*, and very short ones are called *duettino*. The duet form may rise to symphonic grandeur, as witness Beethoven's Kreutzer Sonata for pianoforte and violin, or Schubert's grand pianoforte duo for four hands (op. 140). Indeed the latter has been successfully arranged for the orchestra as a symphony. (As to this last, whatever its success, and even though the "arranger" be Professor Joachim, sincere musicians will always feel regret when the work of a great genius is not left as he finished it.)

DUG'DALE, SIR WILLIAM (1605–1686), was born at Shustoke, in Warwickshire. He early adopted the study of the antiquities of his country, and became at length Garter King-at-arms in 1677, on which occasion he was also knighted. In 1656 he published, at his own charge, "The Antiquities of Warwickshire," and in 1658 "The History of St. Paul's Cathedral." He wrote and published many other works, but the most important one was the "Baronage of England" (1675).

DUGONG' (Halicore) is a genus of Mammals belonging to the order SIRENIA. The dugongs, like the whales, with which they were formerly classed, are entirely aquatic in their habits. The body is long and tapering towards the tail, which is broad and crescent-shaped. There is no trace of hind limbs. The two fore limbs or "flippers" form powerful paddles; they are devoid of claws. The head is abruptly truncated; the snout is furnished with bristles. The upper jaw is provided with two large tusk-like incisors (*a* in annexed figure), which in the female are rudimentary, growth being arrested before they cut the gum. Both jaws are provided with small molars, which vary according to age from twelve to twenty. The body of the dugong is not so well calculated for moving rapidly through the water as that of the dolphin and other Cetacea, which subsist by a perpetual pursuit of living animals. In these the snout is conical and peculiarly elongated, and in some the jaws are produced to an extreme length, so as to give them every advantage in seizing their swift and slippery prey; while in the herbivorous dugong the snout is as remarkable for its obtuse, truncate character—a form, however, which is equally advantageous to it, and well adapted to its habits of browsing upon the algæ and fuci which grow upon the submarine rocks of the Indian seas. As, from the fixed nature of the dugong's food, the motions of the animal during the time of feeding must relate more immediately to the necessity of coming to the surface to respire, its tail, the principal organ of locomotive ascent and descent, is proportionally greater than in the Cetacea, its breadth being rather more than one-third the length of the whole body (Owen).

Three species are distinguished. The commonest, *Halicore dugong* (or *indicus*), is an inhabitant of the Indian seas. These dugongs are tolerably abundant in the Malay Archipelago and on the east coast of Africa. The native Malays spear them at night-time, their presence being

Skull of the Dugong (*Halicore dugong*).

indicated by a snuffing noise. When caught the tail is raised up out of the water, as the animal is quite powerless in this position. The habits of the dugong are gregarious, herding to the extent of 300 or 400 individuals at a single spot. Like whales they display extraordinary attachment to their young, defending them to the death. All accounts agree in considering the flesh to be delicate and pleasant eating.

Another species, *Halicore australis*, is abundant on the north coast of Australia. This species yields a clear oil valuable for medicinal purposes; to obtain this a regular "fishery" has been established. A third species, *Halicore tabernaculi*, is confined to the Red Sea; the specific name is due to the notion that the skin was employed by the Jews in veiling the tabernacle. The dugongs are usually from 8 to 10 feet in length.

DUIL'IUS, CAIUS, the commander who won for Rome her first victory at sea, was consul B.C. 260, during the first Punic (Carthaginian) War. Caius Scipio, the other consul, had been defeated and taken prisoner with his whole squadron, and Duilius on assuming the command invented grappling irons and boarding bridges, with which he hooked on his ships to those of Carthage and made a passage from one to the other. The fight thus turned into one sufficiently near a land fight to enable the Roman courage to prevail over their total ignorance of the sea. A brilliant victory was gained off Cape Mylæ, to the north-west of Messina. The fortunate victor, who thus gained the command of the sea for Rome, received every honour the city could bestow, and the celebrated *columna rostrata*, adorned with the prows or beaks (*rostra*) of the captured ships, was set up in the forum. The base of this column is still to be seen at Rome with the original inscription. For the rest of his life Duilius had by the decree of the senate the exceptional "permission to be preceded by a torch-bearer and a flute-player when he walked in the evening through the streets"—a striking unintentional testimony to the stern simplicity of this noblest period of the ancient Roman republic.

DUKE, the title given to those who are in the highest rank of nobility in England. The order is not older in

England than the reign of King Edward III., and in Scotland the Duke of Rothesay was the first of the title; he was the dissolute son of the pious Robert III. (1390–1406), and his tragic fate is one of the chief incidents of Sir Walter Scott's "Fair Maid of Perth." Previously to that reign those whom we now call the nobility consisted of the barons, a few of whom were earls. Neither baron nor earl was in those days, as now, merely a title of honour. The barons were the great tenants in chief, and the earls important officers. It does not appear that in England there was ever any office or particular trust united with the other titles of nobility, viscount, marquis, and duke. They seem to have been from the beginning merely honorary distinctions.

The English word duke is from the French *duc*, which originally was used to signify "a man of the sword (a soldier) and of merit who led troops." The remote origin is Latin *dux*, a "guide" or a "military commander." The word is used by the Latin writers to signify generally any one who has military command, but sometimes *dux*, as an inferior officer, is contrasted with *imperator*, commander-in-chief. Under the lower empire dux was the title of a provincial general who had a command in the provinces. In the time of Constantine there were thirty-five of these military commanders stationed in different parts of the empire, who were all *duces*, or dukes, because they had military command. Ten of these dukes were also honoured with the title of *comes*, or count. [See COUNT.] Vortigern, the British opponent of Hengist and Horsa, was a Roman duke. Gildas calls him *dux*, not *rex*.

The first person created a duke in England was Edward Prince of Wales, commonly called the Black Prince. He was created Duke of Cornwall in Parliament in 1337. The title is still borne by the Princes of Wales. The oldest dukedom next to this is that of Norfolk, created in 1483. All the dukes of England have been created by letters patent, in which the course of succession has been plainly pointed out. Generally the limitation is to the male heirs of the body. The ducal coronet is composed of a circle of gold, with eight strawberry or parsley leaves of equal height above the rim. The House of Lords contains twenty dukes. A duke is spoken to as "Your Grace," and is addressed by letter as "His Grace the Duke of ——; My Lord Duke." The eldest son of a duke is a commoner, but takes by courtesy the second title (a marquisate usually) of his father. The other sons are styled by courtesy "Lord" before their family name, and all the daughters are styled "Ladies" in like manner.

DUK'INFIELD, a town of England in the county of Chester, situated on the river Tame, 42 miles from Chester and 198 from London by the Midland, and Manchester, Sheffield, and Lincoln railways. It is in reality a suburb of Ashton-under-Lyne, which is situated on the opposite or Lancashire side of the river, and with which it is joined by a handsome bridge. It is partly included in the municipal limits of Staleybridge and wholly in the parliamentary. The manufactures in both towns are very similar, and at Dukinfield there are extensive iron foundries, machine works, brick and tile works, and collieries. Astley's pit, 690 yards in depth, is one of the deepest coal mines in the world. The town contains several churches, chapels for different denominations, schools, a mechanics' institute, and temperance hall. Population, 16,942.

DULCAMA'RA is a drug prepared from the young branches of the Woody Nightshade (*Solanum Dulcamara*). This plant is a common weed in hedges and woods, especially near towns. The stem is shrubby, and climbs in a straggling, zigzag way over other plants, reaching a length of 12 feet and more. The leaves are heart-shaped, except those on the upper parts, which are hastate. The flower has a bright appearance among the leaves, the corolla being purple, centred with a long yellow cone of anthers. The berries are fleshy, of a bright red colour.

In the autumn, when the leaves have fallen, the young branches are gathered and dried for the preparation of the drug. The taste is at first slightly bitter, and afterwards sweetish, whence the name Dulcamara, and its English equivalent Bitter-sweet. This taste is due to a bitter principle which yields by decomposition sugar, and an alkaloid, solania. Dulcamara acts upon the skin and kidneys, but is seldom used by physicians in this country.

DULCI'GNO, a seaport on the eastern shore of the Adriatic, now included within the principality of Montenegro, at its south-western corner. When difficulties arose as to the cession of the districts assigned to Montenegro by the treaty of Berlin, it was arranged that Dulcigno should be substituted for the territory first proposed. Owing to the opposition of the Albanians, however, encouraged for some time by the Turks, considerable delay took place, and it was only after the European powers showed their determination by uniting in a naval demonstration that the cession was effected. Dulcigno, like its northern neighbour Ragusa, has two harbours, one of them very capacious but not easily accessible. There are about 5000 inhabitants, chiefly Mohammedans. It bore in ancient times the name of Olchinium, was called by the Turks Olgun, and by the Servians Ulshin. The Servians obtained possession of it in 1180, and held it till 1408. There are many traces of its Christian occupation during this period, and by reverting to Montenegro it went back to the only portion of the old Servian kingdom which continuously maintained its independence. The Venetians acquired it in 1408 and held it till 1571, when it was taken by the Turks, who retained it till 1880. In the seventeenth and eighteenth centuries Dulcigno was the most noted nest of pirates upon the whole Adriatic, and the present population is chiefly a seafaring one. There are a considerable number of small craft. Large vessels are occasionally built here. Dulcigno is the seat of a Catholic bishop.

DUL'CIMER, a very ancient musical instrument, supposed to be the psaltery of the Hebrews. In the modern form it is a trapezium in shape, has many strings, from two to four or five, to each note, and is struck by a pair of sticks with wooden knobs. The psaltery was a very similar instrument in form, but was played by being plucked with a plectrum instead of, as the dulcimer, being struck with a drum-stick. (The latter is the ancestor of the pianoforte, the former of the harpsichord.) The drum-sticks of the dulcimer are clothed on the one side of the head with leather, and on the other side with thick felt, the use of the two sides in alternation giving the power of producing *forte* and *piano* effects. There is no damping apparatus, the sound of the dulcimer is therefore more or less confused. Great rapidity can be attained on it, and in the open air it is not an unpleasing instrument. It is played with both hands. The compass of the dulcimer is now about three octaves from  upwards. It rises to the dignity of a national instrument in the Persian Caucasus and in Hungary.

DULSE is the common name in Scotland for the sea-weed *Rhodymenia palmata*. It is used for food by the poor on the coasts of Scotland, Ireland, and other countries, and it is sometimes found in the markets. The frond is flat and forked, of a tough, parchment-like texture. The name has also been applied on the south-west coasts of England to *Iridæa edulis*, a sea-weed the fronds of which are not cleft, as in the above, but have a simple rounded outline, tapering to the base. The Pepper Dulse is another of the reddish-coloured sea-weeds, which has a pungent taste. It is known to botanists as *Laurencia pinnatifida*.

DUL'VERTON, a market-town of England, in the county of Somerset, 184 miles from London by rail and 9 miles N.N.E. of Tiverton, stands in a deep valley, watered by the impetuous Barle (a feeder of the Exe), over which there is a stone bridge of five arches. The town consists of two well-paved streets, with channels of water running through them: the houses are mostly well built. The church is an ancient building, with an embattled tower, 60 feet high, at the west end. It has been recently well restored. The scenery in the neighbourhood is of the most romantic character, and the Barle and the Exe are noted trout-streams. Two miles distant from the town are the ruins of Barlinch Abbey. Population of the parish, 1373.

DULWICH (pron. *Dul'lidge*), a suburban village of England, in Surrey, in the parish of Camberwell, about 5 miles south of London Bridge, with stations on the London, Chatham, and Dover and Brighton railways. It is in the vicinity of the Crystal Palace, to which circumstance and the salubrity of its climate it owes its increasing popularity. Here is Dulwich or "God's Gift" College, founded by Edward Alleyne, the player, a contemporary of Shakspeare, in 1612, and an important collection of pictures, originally made for the King of Poland, and bequeathed by Sir Francis Bourgeois in 1811. To this gallery the public are admitted daily free of charge. Alleyne's splendid foundation now supports, in accordance with a scheme sanctioned by the lord chancellor in 1857, an upper and a lower school, of deserved reputation, and thirty-two alms-people, who receive twenty shillings a week each, with apartments and furniture. A new school-house was completed in 1870 from the designs of the late Sir Charles Barry, at a cost of £120,000, which accommodates 700 boys. With the view of attracting a superior class of boys the school fees were at once nearly doubled, and the wishes of the founder in the matter apparently disregarded. There is, however, a lower school in which boys residing in the neighbourhood receive a good middle-class education at a cheap rate.

DU'MACHUS is in some authorities the name of the impenitent thief who suffered beside Jesus. But the apocryphal Gospels give usually Gestas as his name, Dismas (or Desmas) being the name of the penitent thief. Longfellow in the "Golden Legend" adopts Dumachus in preference to Gestas for the name of the impenitent thief.

DUMAS, ALEXANDRE, the most prolific writer of fiction the modern world has seen, was born at Villers-Cotterets, near Soissons, 24th June, 1803.

M. Dumas came of a strangely mingled stock, which may account for the originality of his genius. His grandfather, the Marquis de Pailleteric, belonged to the old *noblesse* of France, and his grandmother was a St. Domingo negress. His father, M. Alexandre Davy Dumas, served with distinction in the wars of the first Napoleon, but after his death his family seems to have fallen into comparative poverty. Young Dumas possessed an accomplishment which is not always associated with literary genius—he wrote an excellent hand, and through the kindness of General Foy he thus obtained a clerkship in the office of the Duke of Orleans' secretary, with a salary equal to about £50 a year. England may claim the honour of first stimulating his genius. He had already written a forgotten volume called "Nouvelles," but it was the sight of Charles Kemble in "Hamlet" which set him in the path of success. He determined to write a drama free from the icy trammels of classicism. His "Henri II. et sa Cour" was received with unbounded applause. Hereupon followed a succession of plays: "Charles VII.," "Christine," "Antony," "Richard Arlington," "Thérèse," "Angela," all of which were successful. But it is as a novelist that M. Dumas attained his greatest celebrity. Those who have read "Monte Cristo" and the "Three Musketeers," with its continuations, "Twenty Years After" and the "Vicomte de Bareelonne," can never grow weary of that wonderful "Edmond Dantès" or of those glorious adventurers, D'Artagnan, Athos, Porthos, and Aramis.

During the height of his popularity M. Dumas earned an income of £30,000 a year. He wrote five romances at once for five French papers. He kept a staff of subordinates, a corps of "underwriters," who worked out the ideas which he sketched in the rough, and returned their labours to their employer for retouching. In short, he was the fly-wheel of an unequalled machine for grinding out fiction by the bushel. Unfortunately the same vivid imagination which enabled him to portray all these wonderful romances led him into all sorts of extravagances. He endeavoured to live the magnificent life which he attributed to his hero Monte Cristo, and thus was always in pecuniary difficulties.

The other facts in M. Dumas' career may be briefly told. He opened a theatre, he started newspapers, he was a candidate for the National Assembly during the Revolution of 1848. In 1857 he visited England during the general elections; in 1860 he was with Garibaldi in Italy, and wrote that great soldier's memoirs. His literary fecundity was unexampled, the catalogue of his works amounting to 1200 volumes. His death, which occurred on the 1st of December, 1870, took place at Puys, near Dieppe, and was the result of a paralytic seizure. His son, M. Alexandre Dumas the Younger, reached fame both as a novelist and as one of the most popular dramatic writers in France.

In person M. Dumas betrayed his negro origin. He had an olive complexion, broad nose, and frizzled hair, while he displayed the Ethiopian fondness for bright colours and eccentricities in dress. But he probably also owed to his gro parentage that vivid imagination which rendered him unique among modern writers.

DUMB CANE. See DIEFFENBACHIA.

DUMBAR'TON or **DUNBAR'TON,** a small county in Scotland, consisting of two separate parts, having an intervening distance of 6 miles between their nearest points. The larger and western part is bounded on the west by Loch Long, by which it is separated from the county of Argyle; the southern boundary is formed by the river Clyde, the eastern by the county of Stirling, and the northern by Perthshire. It is about 36 miles in length from N.W. to S.E. in a straight line, and in the middle about 15 miles in breadth from E. to W. Loch Lomond is not wholly included within the county. The small detached eastern part is half inclosed by Stirlingshire on the north and by Lanarkshire on the south, and measures 12 miles from E. to W. and about 4 miles from N. to S. The whole area of the county is 270 square miles, or 172,677 acres, of which about 15,000 acres are water. Two-thirds of the surface consist of mountains, partially presenting woods, mosses, and moors, and incapable of cultivation. The most remarkable mountains are Ben Voirlich and Benequirach, and those of Arrochar, Luss, Row, and Roseneath, the precipitous summits of which are frequently covered with snow. Ben Voirlich, in the northern portion of the county, and near the northern extremity of Loch Lomond, is 3092 feet above the level of the sea. There are many highly picturesque situations in this county. The contrast of sterile mountains and verdant glens is very striking. Loch Lomond presents the richest description of lake and highland scenery. Its length is 22 miles. It is studded with many beautiful little islands, and its finely wooded shores are adorned with elegant villas. The climate is in general mild, and although not well suited for agriculture, it is remarkably well adapted for pasturage, and especially for the growth of timber; nor is it unfavourable as regards health. The natural copse-wood and plantations cover several thousand acres, and consist of oak, ash, yew, holly, mountain ash, birch, hazel, aspen, alder, crab, thorn, and

willow. The arable land is principally clay, and lies mostly on the south of Loch Lomond and along the Clyde. According to the official agricultural statistics published in 1887, it appears that only 47,000 acres, or about one-fifth of the entire area, is under cultivation. The number of cattle in the county in the same year was 12,000; and of sheep, 70,000. The cattle are chiefly of the West Highland breed. Cows of the Ayrshire breed have been introduced into most of the dairy farms, and more attention is paid to the dairy than formerly. The sheep on the hills are of the small black-faced mountain breeds, with Cheviots in the plains. Farms are of very various extent, but chiefly small. The principal mineral product is coal, of which there is a large field, but of inferior quality. It is wrought at Langfauld, in the southern extremity of the county. In the eastern division of the county ironstone is dug, and conveyed on the Forth and Clyde Canal to the great iron foundry at Carron. Some large quarries of limestone and of freestone are worked. There are also several slate quarries. On the banks of the Leven are numerous and very extensive works for cotton-printing and bleaching fields, the pureness of the Leven water being peculiarly adapted for this process. This stream, which, with the exception of numerous mountain torrents, is the only one worthy of notice, runs rapidly a distance of about 7 miles from Loch Lomond to the Clyde at Dumbarton Castle, and is navigable for lighters. The most extensive Turkey-red dye and print works in Scotland are on its banks, and together with the calico-printing works form the main dependence of the inhabitants of the district. Some large iron-works are established at Dalnotter, and there are also extensive manufactories of paper. The county sends one representative to Parliament—the number of electors being 10,063. The population in 1881 was 75,333.

The county contains numerous remains, such as rude forts and tumuli, of the early inhabitants of Scotland. The Roman occupation is represented by the wall of Antoninus, which skirts the north of the eastern part, and passes through the south-east corner of the main district of Kilpatrick, and by other remains of their work at Duntocher, Cumbernauld, and other places. The old name of the county was *Lennox*, *Levenax*, or *Leven's Field*. It formed part of the Cumbrian British kingdom of Strathclyde, and was occupied by the *Damnonii*, who came from the Cornish branch of the British race.

DUMBARTON, the chief town of the above county, and an ancient royal burgh, is situated on the left or eastern bank of the river Leven, not far from its junction with the Clyde, about 15 miles W.N.W. from Glasgow and 63 W. from Edinburgh, and 421 miles from London by the North British Railway. The town consists of one main street, with numerous intersections of minor streets, and on the whole is tolerably well built. Dennystown, a suburb of Dumbarton, on the right bank of the Leven, and included within the same parliamentary bounds as the latter, was built in 1855 by the late William Denny, of the firm of W. Denny & Brothers, shipbuilders, for the accommodation of their workmen. This district has a population of about 3500. The original burgh, with this dependency, had in 1881 a population of 14,172. It is now purposed by the same firm to build another suburb to accommodate about 2000 families, and at the same time to construct a graving dock that shall be capable of receiving the largest vessels built. At high water the Leven is navigable for large ships to the quay at Dumbarton. About 50 vessels, including steamers and sailing ships, and some of these of large burden, belong to the port. Shipbuilding in every branch is extensively prosecuted in Dumbarton, and forms the central industry of the place. Mechanical engineering and other occupations which relate to the shipyard are also carried on extensively. Dumbarton has a fine wooden pier, with 10 feet of water at low tide and regular steam communication with Glasgow, Greenock, and Loch Long, and is a chief station on the Helensburgh branch of the North British Railway.

The chief buildings are the churches of various denominations, and a town-hall and academy, erected in 1866. The Parliamentary constituency numbers 2501.

Around Dumbarton is presented some of the finest scenery in Scotland. The view of Dumbarton Castle from the mouth and right bank of the Leven is exceedingly picturesque; nor less attractive and still more imposing is that background of mountains in advance of which Dumbarton stands, with Ben Lomond in the distant horizon. Dumbarton Castle crowns a lofty rock, rising up in two points, and inaccessible on every side, except by a very narrow passage, fortified with a strong wall or rampart. The cliff on which the rampart stands is situated at the junction of the Clyde and Leven, and rises to the height of 560 feet. It is one mile in circuit. Considered as the key to the Western Highlands, this castle was always a great object of contention, and has sustained many memorable sieges; but it is now of little strategical importance, as the defence of the Clyde would have to be conducted below Greenock, and in the narrow channel at Dumbarton torpedoes would be more effective than guns.

Dumbarton is governed by a provost, three bailies, and eight councillors. It was made a royal burgh by Alexander II. in 1222, but on or near its site there had been a still more ancient town, called *Alcluid*, the capital of the Strathclyde Britons, while during the Roman period it had formed a naval station under the name of *Theodosia*. Previously to the abolition of the glass duty the chief trade of the town was the manufacture of crown glass. The first steam navigation company formed was one for running a steamer from Glasgow to Dumbarton in 1815.

DUMFRIES', is a southern county of Scotland. It is bounded S. by the Solway Frith and Cumberland, N. by the counties of Lanark, Peebles, and Selkirk, E. by Roxburgh, and W. by Kirkcudbrightshire and Ayrshire. Its form is an irregular ellipse: the greater diameter, from Liddle Mount to Corsincone Hill, measures about 50 miles; the lesser diameter, from the Solway to Loch Craig, about 32 miles. The area is 1103 square miles, or 705,946 acres. The county is divided into three districts—Annandale, Eskdale, and Nithsdale, each comprehending a portion of territory which falls within the basins of the three rivers after which they are named—the Esk on the east, the Nith on the west, and the Annan in the centre. In 1881 the population was 76,140.

Surface, Hydrography, &c.—The surface of the county is very irregular. About half of it is mountainous, a small part is on the sea-coast, and one-third midland, consisting of low hills, ridges, and vales. Hartfell, the highest mountain in the county, is 2651 feet above the level of the sea. In the vicinity of Lochmaben are nine lakes or lochs, five of which are of considerable size. The mountain lake called Loch Skene, situated near the head of Moffat Water, is 1300 feet above the level of the sea, and about 2 miles in circumference. There are several other lakes of less extent. They are all abundantly stocked with fish of various kinds.

The principal rivers in the county are the Nith, Annan, and Esk. The Nith enters the county from Ayrshire, runs S.E. in a very winding course above 40 miles, and falls into the Solway Frith. The Annan takes its rise near the sources of the Clyde and Tweed, among the mountains near the junctions of Lanarkshire and Peeblesshire with Dumfriesshire, runs a course nearly S. of about 30 miles, and enters the Solway Frith a little below the town of Annan. The Esk rises in the mountains on the borders of Selkirkshire, runs in a S. direction about 30 miles in the county, passes

Langholm and Canonbie, enters Cumberland, and turns W., and flows through an open country by Longtown into the Solway Frith. The Kirtle is a romantic little river that enters the Solway Frith a little distance from the Sark, which is a border stream, and forms the boundary between England and Scotland for some distance before it enters the Solway Frith. The Lochar is a moss rivulet, which runs about 13 miles in a very serpentine course, and discharges itself into the Solway Frith, a few miles east of the mouth of the Nith.

Game-birds of various kinds are very plentiful, particularly pheasants, black game, grouse, and partridges. The woodcock, curlew, plover, lapwing, and snipe are also abundant.

Geological Character.—The southern and lower part of the county consists of reddish-coloured sandstone, which becomes of a lighter colour and harder quality towards the north. Still further northward a reddish-coloured limestone appears, succeeded by a coarse white sandstone and blue limestone, and after these mandlestone rock and primitive mountains containing metallic ores. Coals are wrought only at the two extremities of the county, Sanquhar and Canonbie. A great portion of the county is supplied with coal from Cumberland, Lanarkshire, and Ayrshire. The Old Red Sandstone appears in the bed of the Annan, near Jardine Hall. At Wanlockhead, near Leadhills, are extensive lead-mines. From this lead silver is extracted in the proportion of from 6 to 12 oz. in the ton. Gold was formerly found in the mountains at Wanlockhead, in veins of quartz or washed down into the sand of the rivulets. Gypsum occurs in thin veins. The rocks of many of the hills consist of greenstone, and graywacke and graywacke slate. Fletz-trap is found on the summit of some of the mountains. Boulders of granite and sienite are found in various places. There are several basaltic or whinstone rocks, the finest of which are met with in the mountains in the vicinity of Moffat. Sulphurous, chalybeate, and other mineral waters are resorted to in several parts of the county.

The carboniferous strata of this county is remarkable for the discovery of a large number of new fossil species of fish, crustaceans, and scorpions in the fine shales.

Climate, Agriculture, and Manufactures.—That part of the county which adjoins the Solway Frith is low and warm. The mountainous district is cold and bleak, but seldom remains long covered with snow. The whole of the county is considered moist, and is in general mild and salubrious.

The soil in the lower parts is generally of a light and sandy nature. Along the margins of the great rivers are considerable tracts of rich alluvial soil. Peat-moss prevails on many of the hills, and also in some of the vales; the most extensive is that of Lochar, near Dumfries, which is 10 miles long and from 2 to 3 miles broad. Clay is found extensively as a subsoil, and in a few places as a soil mixed with other substances. In Annandale and Nithsdale the dry soil prevails. On many of the hills the soil is naturally wet, but in most cases it affords good sheep pasture. The hills are not generally rugged or heathy, but are mostly of easy ascent. According to the official agricultural statistics published in 1887, it appears that only 240,000 acres, or three-tenths of the entire area, are under cultivation. Bone manure is used with advantage upon high ground of difficult access. The horses in general are of a middle size, and are the result of many crossings of different breeds. The Galloway breed of cattle mostly prevails, except for the dairy, for which many intelligent farmers prefer cows of the Ayrshire breed. The sheep are of the Cheviot and black-faced breeds. A great number of pigs are kept by the farmers and cotters, and bacon may be considered a staple commodity of the county. A large quantity of hams and bacon are also sent to the Liverpool, London, and Newcastle markets. Sheep farms vary in size from 300 to 3000 acres, and two sheep for 3 acres may be considered an average number of stock. Arable farms extend from 50 to 600 acres; many are about 100 or 150 acres. A large part of the county belongs to the Duke of Buccleuch. Most of the modern farm buildings are commodious and well arranged; they are constructed of stone and lime, and generally covered with slate.

The manufactures of the county are confined chiefly to hosiery and tweeds at Dumfries, cotton-spinning at Annan, plaids at Langholm, and some distilleries and breweries in various parts of the county.

There is no division of the county for political purposes, but within its limits are four royal burghs, Dumfries, Annan, Lochmaben, and Sanquhar. The natural division is into the districts or dales of Nithsdale, Annandale, and Eskdale. The synod of Dumfries extends over the whole county, and also over a part of some others. The county sends one member to Parliament, and the burghs of Dumfries, Annan, Kirkcudbright, Lochmaben, and Sanquhar join in electing another representative. The number of voters on the county register is 9489.

Antiquities, History, &c.—The remains of Druidical temples exist in three or four parishes. Near Moffat are vestiges of this kind, and also of a British encampment. A Roman way extended from Carlisle by Gretna. This way afterwards divided into two branches, one of which took the route of Nithsdale and the other of Annandale. They united again at or near Crawford Castle. Another Roman way led from Carlisle by the station at Netherby and Liddel Strength through Canonbie into Teviotdale. Several fortifications, both of a circular and square form, and some large Roman encampments can be distinctly traced in various parts of the county. There are ruins of many old towers, vestiges of forts, and a great number of cairns in different places. Several ancient castles still remain in Dumfries. One of the most interesting is that of Caerlaverock, which, before the invention of gunpowder, was a place of vast strength. It is situated on the shore of the Solway Frith, near the eastern side of the mouth of the Nith. The form is triangular, and it is surrounded by two moats. It stood several sieges, of which one of the most formidable was by Edward I.

The *Selgovæ* were the most ancient inhabitants of this county. In the time of the Romans Dumfriesshire formed a part of the Roman province of Valentia, and after they had relinquished Britain it constituted a portion of a new kingdom founded by Ida and the Angles. In the eighth century it was under the dominion of the Picts, who dismembered Galloway and Dumfriesshire from the Northumbrian monarchy. Until the reign of James VI. this county was the scene of many battles and of many a feud and foray, which were often occasioned by the jealousies of the rival chieftains. Being seated on the borders, it was also liable to the incursions of the English.

Dumfries, the county town of the above county, a port, royal burgh, and parliamentary burgh contributory to the district, is pleasantly situated on the east bank of the Nith, 9 miles above its influx into the Solway Frith, and 334 miles from London by rail. The Glasgow and South-western Railway and the southern section of the Caledonian pass through the town, and thus place it in direct communication with the entire railway system of the country. Dumfries is well built and clean, and has a good supply of water. It is regarded as the provincial capital of the south of Scotland. The houses are of red freestone, the older ones being whitewashed and many of the modern ones painted in imitation of Portland stone. There are several parish churches and places of public worship for different denominations. In the middle of High Street is the Mid Steeple. The other chief buildings are—the county buildings, erected in

1765, in the Scotch Baronial style, including the assize offices; the mechanics' institute, a handsome building, with a great hall capable of accommodating 1000 persons; the town-hall, new exchange rooms, assembly rooms, trades' hall, theatre, academy, infirmary, hospital, almshouses, poor-house, county court-house, a Doric column erected to commemorate the virtues of a duke of Queensberry, and a mausoleum in St. Michael's churchyard over the remains of Burns, to whom a statue also was unveiled opposite Greyfriars Church in 1882. Burns was an exciseman in the town from 1791 till his death in 1796. The Crichton Institution, for invalids of the higher class suffering from mental and nervous diseases, was originally erected in 1839, at a cost of £50,000, and completed in 1872, at an additional cost of £40,000. It commands one of the finest views in the kingdom. The convent, a fine building erected 1881–82, on a hill behind Maxwelltown, which is on the opposite side of the river, commands a beautiful view of the surrounding country. In 1873 Dumfries acquired the estate of Hannahfield, which had reverted to the crown through the intestacy of Mrs. Wood. The estate, valued at about £20,000, was handed over by the Treasury to be applied to educational purposes. The manufactures of the town are hats, tweeds, stockings, shoes, clogs, baskets, leather, and glue, together with the preparation of hare skins and brewing. The weekly cattle markets of Dumfries are well attended, the stock here being generally transferred from Scotch to English dealers. The Nith is crossed by three bridges—one built as early as the reign of Edward I. Vessels of a good size can discharge their cargoes close to the town. There is a quay at the bend of the river near Castledykes. 1½ mile further down; and another near the mouth of the river for vessels of larger size. The foreign trade is in timber from America. The coasting trade is with Liverpool, Whitehaven, Maryport, and other places on the west coast of England, and consists chiefly in the imports of hemp, tallow, coals, iron, tea, and wine, and in the export of cattle and sheep, barley, oats, potatoes, wool and woollen goods, and freestone. The number of vessels registered at Dumfries in 1887 was 30 (3000 tons). The entries and clearances average 600 (35,000 tons) per annum. The customs revenue amounts to £3000 per annum. Population of the burgh in 1881, 17,092. Dumfries returns one member to Parliament in conjunction with Annan, Kirkcudbright, Lochmaben, and Sanquhar.

It is governed by a provost, three bailies, a dean of guild, a treasurer, and twenty-two councillors. Dumfries is said to derive its name from *dun* and *phreas*, a hill-fort among shrubs. It is a place of great antiquity, though it was not made a royal burgh till the twelfth century. In less than a century afterwards, Devorgilla, daughter of Alan, last lord of Galloway, and mother of John Balliol, erected a monastery here for Franciscan Friars; and for the sake of this religious house she built the old bridge, the toll on which formed part of the endowment of the institution. It was here that John Comyn, the heir and representative of Lady Devorgilla, and one of the competitors for the throne, was assassinated, under circumstances of great provocation, in 1305, by his rival, the illustrious Robert Bruce. The castle belonging to the Comyns was situated on a spot in the immediate vicinity of the town, which still bears the name of Castledykes. Being in some respects a border town, Dumfries frequently fell into the hands of the English. It was for some time in the possession of Edward I. It was burnt by the English previously to 1440, and again in 1536. In 1570 the castle was taken and sacked, together with the town, by the Earl of Essex and Lord Scrope. Queen Mary and her privy council, in 1563, ratified at Dumfries a peace with England. James VI., in passing through the town in 1617 on his return to England, presented the trades with a small silver gun, to be awarded from time to time to the best marksman; but this custom has long since been discontinued. The inhabitants in 1706 displayed their opposition to the union of the two kingdoms by burning the articles and the names of the commissioners at the market-cross. They evinced great loyalty towards the reigning family in 1715, and so fortified their town that a large body of insurgents, who had determined to attack it, found it expedient to change their resolution. But in 1745 it suffered severely from the rebel army, which was stationed here a few days on its return from England. Among the famous men who have resided here must be mentioned Thomas Carlyle.

DU'NA or **SOUTHERN DWINA** (in Polish *Dywina*), a river in Russia, rises from several springs in the south-western part of the government of Tver. It winds in a direction generally W. until it has passed Vitebsk, a little above which it becomes navigable for flat-bottomed craft; from this town it turns N.W., in which direction it flows till its entrance into the Gulf of Riga, below Fort Dunamunde, after a course of about 520 miles. The navigable portion of the Duna is about 405 miles in length, but the navigation, owing to rapids and variableness of depth in the river, is difficult and dangerous. At Riga its breadth is about 2500 feet. It contains several islands, and abounds in fish. The chief tributaries of the Duna are—the Toroptsa, the Ulla, the Kasplia, the Ewst, the Mejna, the Disna, and the Bolder-Aa. The Narova, which joins the Duna on its right bank, can be regarded only as an outlet for Lake Peipus. It is connected with the Volga by a canal.

DUNBAR', a royal burgh of Scotland, in the county of Haddington, situated 28 miles from Edinburgh and 370½ from London by the Great Northern and North British railways. The harbour, though rather difficult of access, is safe, and will admit vessels of 300 tons burden. The population of the parish in 1881 was 5396; of the town, 3661. The town is contributory to the Haddington district of burghs. There are several churches and chapels, including a Gothic parish church, with a fine monument to the Earl of Dunbar, who was chancellor of the exchequer in England under James I., some ruins of the old castle, a town-hall, assembly-rooms, public libraries, sailcloth and cordage factories, iron foundries, breweries, and distilleries. The first printing-press in the county was employed here in 1795. The principal imports are coal and foreign grain; the exports consist of corn, whisky, and fish; there are extensive herring fisheries. Dunbar is governed by a provost, three bailies, a treasurer, and seven councillors. The name of the town is said to be derived from *dun-barr*, the fort on the point. It was the scene of St. Wilfrid's imprisonment in 678, and is of some historical importance owing to the successful defence of its castle against the English by "Black Agnes," countess of March, and to Cromwell's decisive defeat of the Scottish army in the neighbourhood, of which a most vivid description is given by Carlyle in his "Letters and Speeches of Cromwell." At Dunbar stood the castle to which Queen Mary fled in 1565, after the assassination of Rizzio.

DUNBAR, WILLIAM (1460–1520), has been often called by his countrymen, with pardonable exaggeration, the Scottish Chaucer. He served as a clerk to foreign embassies in France and England under James IV. of Scotland, who took him from the Franciscan monastery in which he was a friar after leaving St. Andrews University. His chief work is the poem of the "Golden Targe" (1508), an allegory of Reason held as a "targe" or shield to defeat the attacks of Desire, and a very different production from what would naturally be expected from an ex-friar. It is as full of humour and as reckless as Burns' "Jolly Beggars,"

sometimes degenerating into license too free for modern tastes, sometimes really devotional. Its images of the life and manners of his time are most striking, and to the antiquarian quite invaluable. One of Dunbar's state duties was to bring Margaret of England (daughter of Henry VII.) to her new home, as Queen of Scotland, in 1503. He celebrated the event by his "Thrissil and the Rois" (the Thistle and the Rose), by many held his best work. In 1834, probably after having been urged by Sir Walter Scott, a great admirer of Dunbar, Laing first published a complete edition of Dunbar's poems at Edinburgh. This edition is in two small volumes 8vo. It was republished with a supplement in 1865. Paterson's "Life and Poems of Dunbar" appeared in 1860.

DUNBLANE or **DUMBLANE**, a market-town of Scotland, in the county of, and 28 miles S.W. from Perth, and 424½ from London by the Caledonian Railway. It consists of a street of old-fashioned houses, but was formerly an episcopal city. Its situation, overhanging the banks of the Allan Water, over which is an ancient bridge, is very beautiful. Its chief buildings and institutions are the Leightonian Library, a fine hydropathic establishment in connection with some mineral springs, and a beautiful ancient cathedral, the choir of which is now used as the parish church. It was carefully repaired in 1872, some of the former closed windows reopened, and the heavy wooden galleries cleared out from the inside. Population of the parish, 3129; of the town, 2186. Leighton was bishop of this diocese from 1662 to 1669. Near this place, in 1715, the battle of Sheriffmuir was fought between the forces of the Pretender and the royal troops. Dunblane means the "hill of Blane," from St. Blane, an Irish Pict, who is said, about the seventh or eighth century, to have founded a church here.

DUN'CAN, King of Scotland, whom Macbeth killed in battle in 1040, two years before Edward the Confessor reigned in England, is historically a very different personage from that good old king whom we admire in the pages of Shakspeare—

> "So clear in his great office that his virtues
> Will plead like angels, trumpet-tongued, against
> The deep damnation of his taking off."

Macbeth was an under-king, and did homage with his over-lord Malcolm, king of Scotland, to Canute of England in 1031. Duncan was the grandson of this Malcolm, and as such was probably much younger than Macbeth. When Duncan came to the throne he and the under-king quarrelled and fought, and Duncan was slain. Macbeth succeeded him, and ruled for seventeen years. The story of the murder of Duncan is an interpolation of Shakspeare's for the sake of effect. It is modelled on the murder of King Duff by the chief Donwald and his wife, when that king had gone to visit him at his Castle of Forres, and is told in Holinshed—as is also a version of the historical Duncan and Macbeth episode. The powerful character of Lady Macbeth, elaborated from the hint of Holinshed as to the ambition of Donwald's wife, is so far from being just to Macbeth's queen that all we know of Gruach (her name) is her beneficence to many of the Scottish churches.

DUNDALK', a seaport, market-town, and till lately parliamentary borough of Ireland in the county of Louth, situated near the mouth of the Castletown, at the head of a wide bay. It is the county town, and has the usual buildings for the transaction of the county business, a linen-hall, assembly-rooms, and several benevolent institutions; a flax-spinning mill, pin factory, distillery, breweries, and flour-mills. It carries on a brisk trade in grain and other produce, greatly increased in consequence of harbour improvements. These now enable vessels drawing 16 feet of water to come up. The rise of the tide at the bar is 16 feet; at the bridge, 7 feet. Steamers ply regularly to Liverpool. The sea fisheries are actively prosecuted. At Tagher, near Dundalk, Edward Bruce, who proclaimed himself king here, was defeated and slain, 5th October, 1318. Prior to the Redistribution Act the borough returned one member to Parliament. The population in 1881 was 11,974.

DUNDEE', a royal and parliamentary burgh in Forfarshire, on the east coast of Scotland. It is situated on the north bank of the estuary of the Tay, 8 miles from the German Ocean; is distant by rail 22 miles from Perth, 42 from Edinburgh, 80 from Glasgow, 73 from Aberdeen, and 450 from London. In population, as a manufacturing centre, and as a seaport, Dundee ranks third among Scottish towns. It is the principal seat of the jute and linen trades, and has extensive shipbuilding yards. The population in 1881 was 140,239. The Tay, accessible by the largest ships, affords anchorage for a great fleet of vessels, and as a seaport Dundee is growing in importance. The town is built on an imposing situation. It stands on sloping ground, rising from the river level to a height of over 400 feet. Immediately behind the town, in the centre, is Dundee Law, a dome-shaped hill 571 feet high; to the west is Balgay Hill, nearly as high, and well wooded; and to the east is the high-lying ground of Craigie. The larger part of Dundee is built on the hill-side, and the massive buildings, rising one above the other, the graceful contour lines of the slopes, and the fringe of green uplands peering above the smoky factories beneath, form, when seen from the river, a beautiful and striking scene. Queen Victoria landed at Dundee in 1844, and in her "Journal of Our Life in the Highlands" she wrote—"The situation of the town is very fine, but the town itself is not so." This reproach as to the internal appearance of the burgh has been largely removed by the operations of the Police Commissioners during the last ten years. Within that time, in pursuance of a scheme of public improvements, many blocks of buildings have been demolished, narrow streets removed and handsome wide thoroughfares opened, and the aspect of the interior of the town totally altered. *Its former confused and crooked streets gave it all the characteristics of an old-fashioned, sixteenth-century city; the broad,* straight roadways now traversing it, well filled with busy traffic, show that its inhabitants are abreast of the times.

In the beginning of this century a variety of trades were carried on in Dundee. Among other things the town was noted for its coarse woollens or plaidings, linens, bonnets, sewing thread, cotton yarn, leather, and glass. These goods were largely exported to the Continent. With the cessation of bounties, however, and the adaptation of steam power for every kind of manufacture, several branches of industry were abandoned. The linen trade survived, and Dundee has become the principal market in Scotland for linen goods, the linen manufacturers in Arbroath, Forfar, and the Fife towns disposing of their wares in the Dundee market. The first power-loom factory in Dundee was erected by the Messrs. Baxter at Dens Works in 1836. This firm now possesses one of the largest factories in the town, and employs upwards of 4000 workpeople. Their consumption of flax exceeds 7000 tons per annum, and they manufacture the canvas used in the British navy. Other large linen works are those of Messrs. Don Brothers and of Messrs. Buist & Co. The principal industry of the town, however, is the manufacture of jute. This coarse Indian fibre was brought under the notice of Dundee manufacturers in 1824, but it was not until 1833 that the spinning of pure jute was successfully accomplished. Since then its manufacture has been largely developed, about 140,000 tons of raw material being now consumed in the town annually. It is wrought chiefly into sacking, but of late improvements have been made in the method of treating it, and a large trade is done in jute carpets, curtains, upholstery, &c., and jute yarn is spun for mixing with silk and other materials. Establishments for the manufacture of jute have been erected in London, Barrow, Glasgow, and

Aberdeen, but nowhere have they been so successful as in Dundee. Calcutta possesses a number of jute factories, some of which are in the hands of Dundee capitalists. The southern markets are supplied from India, but Dundee controls the European and North American markets. The largest jute work in the town is that of Messrs. Cox Brothers at Lochee. It contains an area of over 20 acres, the greater part of which is covered with buildings, in which the preparing, spinning, bleaching, dyeing, weaving, and finishing of the material is carried on by the most approved processes. An imposing chimney shaft, 282 feet in height, built after the style of an Italian campanile, is a prominent landmark for many miles around. Messrs. Cox Brothers employ about 6000 workers. The average import of jute into Dundee is now more than 130,000 tons per annum; and of flax, tow, and hemp, upwards of 30,000 tons. All this jute and about one-fourth of the flax were spun and woven in Dundee, and it is estimated that the capital invested in the manufacture of jute is £6,500,000, and in the manufacture of linens £1,150,000. About 40,000 workers are employed in the jute trade, and about 10,000 in the linen trade. The larger portion of the workers are women, and the last census shows that the female population exceeds the male by nearly 30 per cent. Their wages average 10*s.* to 12*s.* per week. Other industries of note in the town are the manufacture of leather and of confections and preserves, both of which industries have been considerably extended in recent years. Dundee possesses a large fleet of whalers, and is now at the head of the whale-fishing industry. About twelve steamers proceed to the whale-fishing, and they make two voyages each year, one in spring to Greenland or Newfoundland for seals, and one in summer to Davis' Strait for whales. During the last ten years the average catch has been 950 tons of seal oil (value, £23,500), 840 tons of whale oil (value, £33,000), and 80 tons of whalebone (value, £34,500). The seal skins have now become an important article of commerce. In 1875 a close time was instituted for British vessels engaged in the Greenland seal fishing.

The harbour of Dundee consists of four wet docks and two graving docks. The first wet dock was built between 1815 and 1830. Extensions have been made at various times, and the total dock area approaches 34 acres. Owing to the large size of vessels frequenting the port the construction of a dock of increased depth of water is contemplated. The port is administered by the harbour trust, a body representing the town council, shipowners, chamber of commerce, and other corporations. It has spent £850,000 on dock works. The harbour debt amounts to £350,000, and the revenue to £50,000 per annum. About £140,000 is collected annually in customs duties. Nearly 8000 vessels enter and leave the port every year, their united tonnage exceeding 1,000,000 tons. The largest are the jute ships from Calcutta. Upwards of eighty of these fine vessels, averaging about 1500 tons each, arrive every season; and in spring and summer the docks, well filled with their noble and massive forms, afford an interesting sight. Over 100 vessels, principally steamers of from 600 to 1000 tons, arrive in the course of the season with flax from the Baltic ports. The vessels belonging to Dundee number 190, of 102,749 tons. Four shipbuilding firms are established in the town. They launch about 20,000 tons of shipping every year, and several ocean steamships of 4000 tons and upwards have been built at the port.

There are few open gardens or squares in Dundee, and the town may be arranged in three zones—(1) the centre, occupied by merchants' offices, public offices, and large shops; (2) the middle ring, occupied by factories, whose machinery is continuously whirring and humming, and the tenements which form the dwellings of the working classes; and (3) the suburbs, an outer ring of terraces and villas, where the wealthier classes reside. The town possesses many ornate public buildings. In Albert Square stands the Albert Institute, a handsome Gothic edifice designed by the late Sir G. G. Scott, and erected in 1865–68 as a subscription memorial to the Prince Consort. It is now the property of the Town Council, and contains the Free Library (40,000 volumes), a museum, and a picture gallery. An annual exhibition of paintings has been held for several years. These are well patronized, the sales sometimes exceeding £6000. The Royal Exchange, a beautiful specimen of Flemish Perpendicular architecture, contains a handsome reading-room, 77 by 34 feet wide. Adjoining the exchange is a newly-erected capacious market shelter. The Dundee merchants hold their markets on the street in front of the exchange, and the shelter was intended to serve as a market-place in stormy weather, but as yet it is little resorted to. The High School stands in a roomy playground adjoining Albert Square. It was built in 1832–34, and is severely Greek in style. Its massive portico and extensive wings form an imposing termination to Reform Street, which the High School faces. At the other end of this street is the town-hall, erected in 1734 by the elder Adam, an effective building in the Roman style, with piazzas and Ionic pilastres, and surmounted by a spire 140 feet high. Near to the town-hall is St. Paul's Episcopal Church, built in 1852–55 from designs by the late Sir G. G. Scott, the finest piece of ecclesiastical architecture in the town. It cost £13,000, and includes a tower and spire 220 feet high. To the fervour and energy of the late Bishop Forbes, who is buried in the chancel, is chiefly due its erection. Opposite this church, at the east end of High Street, is the Clydesdale Bank, a highly ornamented building in the Italian style. It replaced the old trades hall (demolished in order that the Murraygate might be widened), a building less costly, but whose elevations were much more imposing than those of the new bank. In Bank Street is the Kinnaird Hall, capable of holding 2000 persons, tastefully designed and containing a large organ. The sheriff court, at the top of Lindsay Street, has a striking Græco-Italian façade. In Dock Street is the custom-house, in Roman-Ionic style, the new Sailors' Home, and the Royal Arch, a graceful and profusely decorated structure in stone, erected by public subscription to commemorate the landing of Queen Victoria at Dundee in 1844. In the grounds surrounding the Albert Institute are bronze statues of George Kinloch, a radical outlawed for his political opinions, but returned member for Dundee in the first reformed Parliament; James Carmichael, a Dundee engineer who invented the fan-blast and other machines of much utility; and Robert Burns, the poet.

Undoubtedly the most interesting and most conspicuous piece of architecture in Dundee is the old steeple, a massive ancient tower 156 feet in height. It adjoins the western extremity of three parish churches under one roof. According to tradition the steeple was built in performance of a vow made by David, earl of Huntingdon, who when returning from the crusades about 1174 was in danger of shipwreck, and in his distress besought the aid of Heaven, promising to build a church in honour of the Virgin Mary if he should reach his native shore in safety. From the style of the building—Flamboyant Decorated Gothic—the steeple, or St. Mary's Tower, is believed by antiquarians to have been built about 1400, and Sir William Dischington or Distin, a Fifeshire knight, is surmised to have been the designer. The tower is square throughout, and is in two great stages, each finished by an ornamental parapet. The entrance is by a carved double doorway in the west front. This is surmounted by a noble six-light window, over which in turn is a large rose or wheel window. In 1870–72 the steeple was restored under the directions of Sir G. G. Scott at a cost of £7000, raised partly by public subscription and partly by the town council. A peal of eight large

bells was placed in it at the same time. Originally the steeple was at the west end of a cathedral building, consisting of nave, transept, and chancel, 250 feet in length. This cathedral was richly endowed, but suffered during the political disturbances, and was more than once wrecked. In Protestant times it was formed into four charges. Two of the existing churches date only from after 1841, the old building having been burned in that year, and a valuable library of early printed books destroyed by the flames. St. Mary's and St. Paul's churches, which correspond to the chancel and transept of the old cathedral, have been rebuilt in Decorated Pointed style, but St. Clement's, the nave, remains extremely bald and plain.

In early times the present High Street, now in the centre, was at the extreme west end of the town. The cathedral, adjacent to the High Street, was built outside the burgh boundaries. Fashionable west-end residences were in this neighbourhood, and until a recent date several of them were in existence, including some in which Mary Queen of Scots and other royal personages occasionally resided. The most conspicuous buildings which the burgh improvements have left standing are the "New Tolbuith" on the west side of the High Street, with a flat-capped turret at its north-east angle, and the old custom-house in the Greenmarket, which has a turret at each corner. The original "tolbuith," or town-house, was in Seagate, in which street also the burgh cross was situated previous to 1586, when it was removed to the High Street. After standing there for a considerable period it was taken down, but has recently been erected, as a relic of old times, in the ground in front of the steeple. In Cowgate is the only remaining specimen of the old gates or ports which formerly inclosed the town. It consists of a central archway 8½ feet wide and 11 feet high. The reformer Wishart preached from its top. The many gates in the walls of old Dundee are remembered by the names of streets, Nethergate, Overgate, West Port, Murraygate, Wellgate, Cowgate, and Seagate being leading thoroughfares. At one time the town was rich in religious endowments, which only survive in the titles they have given to lanes and closes. Paul's Close marks the site of old St. Paul's Church; St Clement's Lane was the site of St. Clement's Church; the Church of the Holy Rood has given its name to Rood Yard; St. Roque's Chapel is recalled by St. Roque's Lane; St. Salvator's Close is identified with St. Salvator's Chapel; the Ladywell is associated with Our Lady's Chapel; and Magdalene Green owes its name to a Magdalene establishment at one time situated in its neighbourhood.

Dundee possesses many "mortifications," or endowments, for educational and philanthropic purposes. The largest is the gift (made in December, 1881) of £120,000 by Miss Baxter and £10,000 by the late Dr. John Boyd Baxter for the purpose of founding a university college. With this money a church and several contiguous dwelling-houses have been purchased and equipped as class rooms, and chairs of classics and ancient history, mathematics and natural philosophy, chemistry, engineering, and English literature have been endowed. Miss Baxter has given a further sum of £10,000 for the erection of a first-class chemical laboratory; the trustees of Dr. Baxter have contributed £10,000 to found another chair; and a sum of £20,000, left by the late Sir David Baxter for a Mechanics' Institute, will be available for a like purpose. The college is managed by a council composed of nine *ex-officio* members (the provost, the members of Parliament, the sheriff, &c.), and nine members elected by the governors. The governors of the college consist of persons contributing £5 per annum, or a donation of £50, to its funds. Professors have been appointed, and the college commenced work in the autumn of 1883. The High School was recently endowed with £20,000 by Mr. William Harris, a retired Dundee merchant, the interest of which is chiefly devoted to the payment of a rector. This gentleman also gave the School Board £10,000 to enable it to erect a secondary school. The Morgan Hospital, a handsome and conspicuous edifice, lodges and educates sixty boys, the sons of respectable parents. The town maintains an orphan institution, two industrial schools, and a training ship, which provide for nearly 800 children. The royal infirmary, an imposing building in the Tudor style, has wards for 400 patients. Other philanthropic institutions connected with the town are—a convalescent home, Royal Lunatic Asylum, Curr Night Refuge, sailors' home, and asylum for imbecile children.

The town council consists of the provost, six magistrates, twenty councillors, and the dean of the guildry incorporation. Sitting as the police commission it has charge of lighting, watching, the public parks, drainage, and everything relating to the public health. Since 1871 the police commission have spent about £400,000 on street improvements, and while this has added to the amenity it has materially increased the healthiness of the town. In the four years 1870–73 inclusive, the average death-rate was 26·9 per 1000; in the four years 1878–81 inclusive it was 21·4 per 1000. The gas and water supplies belong to the community, and are managed by commissions representative of the town council and other public bodies. The water supply comes from Lintrathen Loch, in the Grampians, distant 18 miles from Dundee, and from Monikie reservoirs, situated on the high ground to the east of the town.

The public parks include the Balgay Park, purchased by the public commission in 1871, consisting of the beautifully wooded Balgay Hill. It is 60 acres in extent, and commands a magnificent view over the estuary of the Tay and the Carse of Gowrie. The Law Hill has likewise been acquired as a place of recreation. The Baxter Park, 38 acres in extent, is in the east end of the town, and was the gift of the late Sir David Baxter and his two sisters. The Magdalene Green is an open plot of grass, extending to about 20 acres, facing the river at the west end of the town. From this green runs an esplanade, about a mile in length, which leads to the centre of the town. It affords a splendid promenade along the river side. At the west end of the esplanade the unfortunate Tay Bridge entered the town. This bridge was remarkable as being the longest viaduct over tidal water (length, 3450 yards). Its construction was commenced in 1871, from plans by the late Sir Thomas Bouch. His design contained only one line of rails, and consisted of eighty-five spans, thirteen of which, in the centre of the river, were 345 feet in length, and 88 feet above the river level at high water. It was opened for traffic in May, 1878, but on Sunday, 28th December, 1879, the thirteen central girders were blown down during a fierce storm, a passenger train carrying about ninety persons being engulfed in the wreck. A new bridge was constructed (completed in 1887) by Mr. W. H. Barlow, which consists of a double line of rails at a slightly lower level than the former structure. An inquiry respecting the Tay Bridge disaster showed that both the design and the workmanship of the earlier viaduct were defective. Dundee returns two members to the House of Commons.

In Scottish history it is a place of much importance. Its name, formerly written Dondo, Dondie, and Dondei, is held to be a variation either of the Latin *dei donum*, the gift of God, or of the Celtic *duntaw*, the hill of Tay. In the time of the Romans it is believed to have been a place of strength, and on the summit of the Law Hill may be seen traces of a Roman camp. The town is associated with events occurring under Elpin, king of Scots, 834; Malcolm II., 1010; Malcolm Canmore, 1071; and under Edgar, 1106. It received its charter from Alexander III., and for a considerable period after this it rivalled Edinburgh, Perth, and Stirling in commercial and

political importance. In 1291 Edward I. took possession of and sacked Dundee. His tenure was disputed by Wallace, and when the English monarch made a second raid into Scotland, in 1303, he subjected the town to conflagration. While in Edward's possession the town was successfully besieged by Wallace's force under Alexander Scrymgeour, who for his bravery was created by Wallace hereditary constable of Dundee, and his family was for long identified with the district, one member becoming Viscount Dudhope. In the time of Bruce the town was assaulted at intervals alternately by the English and the Scotch, and was burnt more than once. It enjoyed peace after Robert Bruce's supremacy was assured, and that monarch granted it a new charter. The Reformation brought Dundee into prominence, Wishart opening a revival crusade here in 1544 while a pestilential plague was raging. Henry VIII. took possession of the town in 1547, and on retiring burnt the churches and many houses. The Queen Regent's army then occupied it, but the citizens supported the Reformers, and a body of them marched to aid the Reform army at Perth. In 1645 the Marquis of Montrose stormed the town and burnt down several portions. Charles II. was sumptuously entertained by the inhabitants previous to his march to Worcester in 1651. In the same year General Monk besieged and plundered Dundee, and it is stated that each soldier in his army received loot valued at £60 sterling. Before the battle of Killiecrankie Viscount Dundee ("Bonnie Dundee") threatened the town, but was successfully resisted by the inhabitants. In 1715 it was entered by the Pretender, and from September, 1745, to January, 1746, it was held by 600 of Prince Charles Edward's men. Before the days of long-range guns, Dundee was a place of easy defence. Its commerce and easy communication with the Continent made it a place of much value to combatants, especially to the English, and it was consequently the scene of many desperate encounters.

DUNE is a name given to hills and ridges formed of blown sand. They generally occur on the sea-coast, but are also found on the shores of large lakes and in sandy deserts. On the Norfolk coast they stretch some distance, frequently reaching a height of from 50 to 60 feet; they are found on parts of the Cornish coast, *e.g.* near Hayle and Madron; they stretch for miles along the coasts of France, Belgium, Holland, and the south Baltic. The dunes of the sea-coast of the Netherlands and of the north of France have been raised by the action of the winds from the German Ocean, by which the loose sand of the beach left uncovered at low tide has been blown inland and deposited in gradually increasing heaps or mounds. In some places these hills have been planted with a kind of bent grass, which serves to hold the surface together, but most of them are wholly barren. They are invaluable as barriers against the encroachments of the sea, and they occupy an important place in the protection of the cultivated lowlands of the coast against inundation. They are also found on the east border of the Caspian, the south-east border of Lake Michigan, and in Sahara, Arabia, Utah, and Arizona. On the Dutch coast they occasionally reach a height of 250 feet, the breadth of the sand belt being at parts as much as 5 miles. As the amount of sand increases by disintegration, it travels inwards before the wind, often committing serious ravages. The amount and rate of this inward progress vary greatly. In the Bay of Biscay the sand advances at the rate of 16½ feet per annum, but on these coasts circumstances are favourable to a rapid progress.

In Egypt, Syria, and Asiatic Turkey temples and cities have been buried under accumulations of drifted sand. Houses and churches have been covered in Cornwall and the west coast of France; on the shores of Michigan forests have been submerged, only the tops of the trees appearing above the sand. Sand drifts have diverted the course of rivers—for example, that of the Oxus and of the Adour (a river in the west of France).

The advance of dunes is often checked, or even prevented, by plants, the fibrous roots of which bind the sand together, rendering it compact enough to resist being scattered by wind, while at the same time it is thus able to act as a barrier to sand advancing from the coast. Plants which thrive in sandy soils, such as the common sand carex, are often encouraged on this account. The dunes in many parts of the west coast of France are planted with pines, and their advance effectually checked.

Dunes in many cases consist of little but pure sand, and in this case have almost no coherence. Not unfrequently, however, ferruginous or calcareous particles (for instance, fragments of shells) may be mixed with the sand, and rain water (containing a little carbonic acid), percolating through, dissolves and redeposits carbonate of lime or oxide of iron, thus cementing the particles together. Thus dunes in the Bahamas and Bermudas have hardened into solid stone; and a similar rock is found in Cornwall compact enough to serve as a building stone.

DUNE'DIN, the capital of the provincial district of Otago, and the largest, best built, and most important commercial city in New Zealand, is situated in county Taieri, on a picturesque site at the south-western side of a bay running inland, about 9 miles from Port Chalmers, with which it is also connected by a railway. The settlement of Otago was projected in 1846, and under the auspices of an association of members of the Free Church of Scotland Dunedin was founded in 1848. From the exclusive nature of its first settlers, and the natural difficulties to be overcome in a new country, it made little progress till 1861, when gold-fields of extraordinary richness were discovered at Gabriel's Gully, about 72 miles from the town. Crowds of diggers poured in from all parts of Australia, and from this date Dunedin became a scene of busy industry. Its streets are now paved and well lighted. It is supplied with water from a reservoir constructed at the head of the Water of Leith valley. During the last few years a large number of substantial buildings have been erected, giving an air of permanency and wealth to the business portion of the city.

Its chief buildings and institutions are several Episcopal and Presbyterian churches and other places of worship for various denominations, among which is a Roman Catholic cathedral; two theatres, an hospital, the largest in New Zealand, lunatic asylum, botanical gardens, university and museum in connection with it, government offices, and town-hall. The municipal business is conducted by a mayor and twelve councillors, three of whom represent each of the four wards. The chief exports are wool and gold, and next to these preserved meats, wheat, and tallow. The climate is healthy, and the uniformity of temperature remarkable, there being no extremes of heat and cold; annual mean temperature, 51·4° Fahr., the same as that of the Isle of Wight; rainfall, 32·5 inches; number of rainy days, 140; the number on the east coast of Scotland, 142. The population numbers 26,000, with an additional suburban population of 14,000.

DUNFERM'LINE, an important manufacturing town, parliamentary and municipal burgh, and royal city of Scotland, in the county of Fife, situated 15 miles N.W. from Edinburgh, 3 N. from the Frith of Forth, and 433 from London by the Great Northern and North British railways. The town stands on a long swelling ridge, 300 feet above the sea, and has a very imposing appearance when seen from the south. It formerly contained one of the richest abbeys in Scotland, founded by Malcolm Canmore in 1072, of which the nave of the church remains; and adjoining the east end is the parish church, a very fine building erected in 1818. The tomb of Robert Bruce was

discovered during its construction. His skeleton was disinterred and a cast taken of the head. Other royal interments within the precincts of the abbey included eight kings, five queens, six princes, and two princesses of Scotland. In addition to those of the abbey there are many other interesting ruins. Table linen is the chief manufacture, and there are also iron and brass foundries, forges, tanneries, rope-works, flour and tobacco mills. In the neighbourhood are several collieries and limeworks, and freestone and whinstone are quarried. Coal has been raised since 1291. There are several good public buildings in the town, including a town-hall, county buildings, large music hall, the lower part being used as a theatre and on market days as a corn-exchange. The places of worship are numerous, and there are several good schools. The parliamentary burgh, included in the Stirling district of burghs, has a population of 17,084.

Dunfermline can boast of great antiquity. A tower or fort built here by Malcolm Canmore in the eleventh century gave origin to the burgh. It continued to be a favourite royal residence as long as the Scottish kingdom existed. Charles I. was born here, as also his sister Elizabeth, afterwards Queen of Bohemia; and Charles II. paid a visit to this ancient seat of royalty in 1650. The Scottish Parliament was often held in it. The date of the erection of the palace is unknown, but it is believed to have been much extended and adorned by James IV. and James V. There now remain only the south wall, and a vaulted apartment, which was the king's cellar, having the kitchen above. Of the tower erected by King Malcolm only a mouldering fragment remains.

The secession from the Established Church in 1732 originated here. Of the Messrs. Erskine, regarded as the fathers of the secession, one, Mr. Ralph Erskine, was minister of the Abbey Church of Dunfermline. The Relief Church also originated here in 1752, by the deposition of Mr. Thomas Gillespie of Carnock, in honour of whom an elegant church was erected in 1849.

DUNGAN'NON, a market-town and formerly a parliamentary borough of Ireland, in the county of Tyrone, Ulster, 24 miles S.E. by E. from Omagh, and 94½ N.N.W. from Dublin, consists of four principal and some smaller streets, built on the declivity of a hill. It is regularly laid out, and contains a market-house, court-house, bridewell, union workhouse, parish church, Roman Catholic, Presbyterian, and Methodist chapels. It also contains an endowed college founded by Charles I., the lands of which produce a yearly rental of about £1500. A good deal of business is done in weaving and bleaching linen; fire-bricks, tiles, and coarse earthenware are also made, and there is a good trade in agricultural produce, lime, and coal. The town has been much improved by the proprietor, the Earl of Ranfurly. The independence of the Irish Parliament was proclaimed here in 1782. It was the ancient residence of the kings of Ulster. The borough returned one member prior to the Redistribution Act of 1885. Population in 1881, 4084. Dungannon gives the title of viscount to the family of Trevor.

DUNGAR'VAN, a seaport, municipal borough, and formerly a parliamentary borough of Ireland, in the county of, and 25 miles S.W. from Waterford, is situated on both sides of the estuary of the small river Colligan, at its entrance into the bay called Dungarvan Harbour. A good stone bridge of one arch connects the two portions of the town. The streets are mostly narrow. There are a market-house, a town-hall (a fine structure, with a granite front), a national bank, a church, and two Roman Catholic chapels, two convents, a monastery, sessions-house, and an ancient castle used as a barracks. Vessels of not more than 250 tons can discharge at the quay. The chief exports are grain, butter, cattle, and fish. Dungarvan is governed by a board of fifteen town and harbour commissioners, who have recently improved the port. The parliamentary borough was disfranchised by the Redistribution Act of 1885. The population in 1881 was 7391, many of whom were engaged in the hake, cod, and herring fisheries. Dungarvan has been greatly improved of late years by the Duke of Devonshire, who has much property in the town and country, and it has now altogether a very neat and clean appearance. It is resorted to during the summer for sea-bathing. There are some remains of an Augustinian abbey, founded by St. Garvan in the seventh century (the suburb of the town on the other side of the river is called Abbeyside), and a portion of the walls built by King John—who also erected the castle, yet in use—are still standing.

DUNG BEETLE is a name given to many beetles of the family SCARABÆIDÆ, from their association with the substance which forms in many cases at once their food and dwelling-place. Many dung beetles are found in England, and of these the commonest is the Dor Beetle (*Geotrupes stercorarius*), to which Shakspeare refers in "Macbeth":—

> "Ere to black Hecate's summons
> The shard-born beetle with his drowsy hums
> Hath rung night's yawning peal."

This beetle excavates large holes, often of considerable depth and forming elaborate tunnels, beneath a heap of dung. In these holes the eggs are deposited, having been first enveloped singly in a mass of dung. In this way the excrements of animals are removed gradually from the surface of the earth, and rendered both inoffensive and useful. The dor is a little less than an inch in length, and of a bluish-black colour. Other dung beetles form pellets of this substance, inclosing within each pellet an egg. These little balls of dung are then rolled along and buried in holes in the ground. In the case of one of these beetles, however, the Sacred Scarabæus of Egypt, it seems that no eggs are deposited in the pellets, which are rolled into the beetle's burrow as food.

DUN'ITE, a rock constituting a great part of the Dun Mountains in New Zealand, whence its name. It consists of olivine (more or less altered to serpentine) with chrome iron, and sometimes small quantities of diallage and enstatite. Dunite is also found in the south of Spain.

DUNKELD', a burgh of barony and village of Scotland, in the county of Perth, on the left bank of the Tay, with a station on the Highland Railway, 15 miles N.W. by N. from Perth, and 466 from London. This town derives much benefit from visitors, who are attracted to it by the great beauty of its situation and its convenience as the point of entrance upon the Highlands. The chief buildings are a city hall, an Independent chapel, and a Free church. There is a fine bridge of seven arches over the Tay, communicating with Little Dunkeld, which parish has a population of 2175. The inhabitants of Old Dunkeld parish number only 791; of the village, 768. The most imposing object in Dunkeld is its cathedral, situated on the banks of the Tay—an edifice partly Saxon and partly Gothic, and the remains of which, owing to the care of the family of Athol, are both extensive and in good preservation. The choir of the building is used as the parish church. Different portions of the cathedral were erected at different times, but the oldest, the choir, was built in 1350. Gawain Douglas, who translated Virgil's Æneid, and Henry Guthrie, author of "Memoirs of Scottish Affairs from 1637 to the Death of Charles I.," were both bishops of this see. The Culdees had a monastery here so early as 729. When Iona, the original and chief seat of that order, was ravaged by the Danes in the ninth century, the primate resided for some time in Dunkeld, but was afterwards transferred to St. Andrews. "But the rank of the abbots of Dunkeld," says Pinkerton, "one of whom was the father of a royal race in Scotland, and another Ethelred, the son of Malcolm III., sufficiently marks the estimation in which that dignity was

long held." The monastery, however, was changed by David I. into a cathedral in 1127, at or about which period the system of the Culdees was superseded throughout Scotland by that of the Roman Catholics. The Duke of Athol's grounds, which are unsurpassed in Scotland for beauty, lie on the W. and N. of Dunkeld, and comprise 50 miles of walks, 30 miles of drives, and no less than 20 square miles of larch-wood, including the first two larch trees planted in Great Britain (1737). Three miles south of Dunkeld stood Birnam Wood, immortalized in Shakspeare's tragedy of "Macbeth."

DUNKIRK or **DUNKERQUE** (*Duyn Kerche*), a seaport town and fortress in the department of Nord, France, stands at the junction of the canals of Bergues, Bourbourg, and Furnes, 174 miles N. by E. from Paris. The town had 36,149 inhabitants in 1886. It owes its origin to a chapel founded by St. Eloi, which, from its situation among the sandy downs of the coast, got the name of Duyn Kerche, which in Flemish means "the church of the downs." In the tenth century it was raised by Baldwin III., count of Flanders, from a mere village to the rank of a town. Charles V., to whom the town had come by inheritance along with the rest of Flanders, built a castle to defend the port, which has been since demolished. In 1558, the English, who had made themselves masters of the town, were driven from it by the French; but in the following year it was given up to the Spaniards. In 1646 it was taken from the Spaniards by the French under the Duke of Enghien (afterwards the Great Condé), but it fell again shortly after into the hands of the Spaniards. In 1658 Turenne, having defeated the Spaniards, took Dunkirk, which, according to a treaty previously concluded with Cromwell, was put into the hands of the English; four years afterwards Charles II. restored it to France on condition of receiving for it a considerable sum of money. Louis XIV., by the fortifications he erected, enabled the town to repel an attempt made by the English to bombard it in 1695. By the peace of Utrecht the fortifications were razed. At the peace of Aix-la-Chapelle the fortifications, which had been partly restored in the previous war, were again demolished; but by the peace of 1783 they were allowed to be restored. In 1793 the town was besieged by the allies under the Duke of York, but the French obliged the besiegers to retire with great loss.

Dunkirk is nearly 3 miles in circuit. The streets are broad and well paved; the houses are well built, of brick. The public squares are spacious, handsome, and regular. The principal of these are the Champ-de-Mars and the Place Jean Bart, which is planted with trees and ornamented with a statue of Jean Bart. The extension of the town has required the removal of the old fortifications. The principal buildings are—the Palais de Justice, the Church of St. Eloi, which, though a Gothic structure, has a handsome Corinthian portico; the detached belfry in front of this church; the town-hall, the barracks and naval storehouses; the tower of the port, on which there is a lighthouse; the college, theatre, and concert rooms.

The inhabitants are engaged in the manufacture of soap, starch, beer, beet-root sugar, cordage, and leather; there are metal foundries, jute and flax mills, gin distilleries, salt-works, and shipbuilding yards. The trade by sea is very considerable, and steamers run regularly to all the principal ports of the United Kingdom. The harbour is large and safe, but of rather difficult entrance. There is a break-water of 1000 yards in length. The cod and herring fisheries are prosecuted with great activity, and the town has a considerable trade in Bordeaux wines and brandies.

Dunkirk has tribunals of first instance and of commerce, a chamber of commerce, a public library of 18,000 volumes, an exchange, a college, a school of navigation, and two hospitals. Foreign consuls reside at Dunkirk.

DUN'LIN (*Tringa alpina*) belongs to the same genus as the SANDPIPER and the same family (Scolopacidæ) as the SNIPE. It is about 8 inches in length. The difference between the bird in its summer and in its winter dress is so great that it was long supposed to form two species, distinguished under the names of the Dunlin and the Purre. In winter the plumage is ashy above and white below; in summer the breast is marked with a large black horseshoe-shaped patch. The dunlin is diffused over the whole northern hemisphere, and migrates to high latitudes in the spring to breed; in this country it is abundant on the sea-coasts during the autumn and winter, but appears to breed only in the most northern parts of Scotland, and in the Orkney and Shetland Islands. It frequents flat sandy shores, where it is seen in constant activity, running along or taking short flights near the edge of the water, and continually probing with its bill in search of the small crustacea on which it chiefly feeds. It is gregarious in its habits, being found in large flocks of 200 or 300.

DUN'MOW or **GREAT DUNMOW**, a market-town of England, in the county of Essex, situated on an eminence on the south-western bank of the Chelmer, 42 miles N.N.E. from London by the Great Eastern Railway. The town consists principally of two streets. The church is ancient and spacious, with an embattled tower. Population of the parish, 3005. The village of Little Dunmow about 2 miles E. from Great Dunmow, had formerly a priory, and some parts of the priory church are incorporated in the present parish church. The famous custom of the manor of Little Dunmow is to deliver a flitch of bacon to any married couple who take the following form of oath—

"You shall swear by custom of confession,
That you ne'er made nuptial transgression;
Nor since you were married man and wife,
By household brawls or contentious strife,
Or otherwise at bed or at board,
Offended each other in deed or in word;
Or since the parish clerk said Amen,
Wished yourselves unmarried again;
Or in a twelvemonth and a day,
Repented not in thought any way;
But continued true in thought and desire,
As when you joined hands in holy quire.
If to these conditions without all fear,
Of your own accord you will freely swear,
A whole *gammon of bacon* you shall receive,
And bear it hence with love and good leave;
For this is our custom at Dunmow well known:
Tho' the pleasure be ours, the bacon's your own."

The custom has been ascribed to early Norman or even Saxon times, but is of uncertain origin. During six centuries only seven couples have been able to claim the prize. The last occasion was in 1763. An attempt was made by the late Mr. Harrison Ainsworth to revive the practice, but it was not successful.

DUN'NING, JOHN (Baron Ashburton), an eminent lawyer and statesman of the time of George III., was born at Ashburton, in Devonshire, 18th October, 1731; and died at Exmouth 18th August, 1783. He was for many years member for Calne, in Wilts, but first rose into distinction as a lawyer through his able defence of the East India Company against certain charges which had been made against the company by the Dutch merchants, and as counsel for "the patriot Wilkes." He was made recorder of Bristol in 1766, solicitor-general in 1767, and created a peer, under the title of Baron Ashburton, in 1782. He was the author of the celebrated motion, which he carried in the House of Commons in 1780, that "the influence of the crown had increased, was increasing, and ought to be diminished."

DUNOON', an increasing popular watering-place of Scotland, in the county of Argyle, situated on the west side of the Frith of Clyde, 7 miles west of Greenock, in a situation more remarkable for strikingly picturesque features than perhaps any other similar town on the Clyde. On a conical

hill near the pier stand the ruins of Dunoon Castle, once a royal palace, and subsequently, till about the end of the seventeenth century, the residence of the family of Argyle. Here the Campbells in the seventeenth century treacherously massacred a number of the Clan Lamont, who were guests at the castle. The view from the Castle Hill is one of the most extensive and variegated on the frith, stretching from near Dumbarton Rock to Ailsa Craig, and comprehending the coasts of Dumbartonshire, Renfrewshire, Ayrshire, Argyleshire, and Buteshire. The principal buildings are the burgh buildings, the West of Scotland Convalescent Seaside Homes, and the parish, free, and united presbyterian churches. There are also several hotels. Population in 1881, 4692.

DUNS SCO'TUS, one of the five great Schoolmen (Albert the Great and Aquinas, Dominicans; Bonaventura, Duns Scotus, and Ockham, Franciscans), was born probably about the year 1265. The English, the Scotch, and the Irish have all claimed him as a countryman. It seems, however, to be agreed that he was chiefly educated in England. He is said to have been found when a boy tending his father's cows by two Franciscans, who were greatly struck with his intelligence; and by the monks of this order he was first instructed in the elements of learning, and then sent to Merton College, Oxford, of which he became a fellow. While a student he is said to have become greatly distinguished for his proficiency in theology, in logic and metaphysics, in civil and canon law, in mathematics, in natural philosophy, and in astronomy. In 1301, on the removal of William Varron to Paris, he was appointed to the theological chair. His prelections were attended by crowds of auditors, the number of students at Oxford at this time, it is affirmed, exceeding 30,000, which is manifestly a great exaggeration. In 1307 Duns removed from Oxford to Paris, in which city he had on a visit some time before distinguished himself in an extraordinary manner by his defence, in a public disputation, of the doctrine of the immaculate conception of the Virgin Mary. On this occasion, it is said, there was formally conferred on Duns the title of the "Subtle Doctor" (Doctor vel Magister Subtilis), by which he is commonly distinguished. He taught in his new chair with as much applause as at Oxford; but in 1308 he was ordered by the general of his order to remove to Cologne to found a new university there. On reaching Cologne he was met by nearly the whole body of the citizens, and drawn into the city in a triumphal car. On the 8th of November of the same year he was carried off by a fit of apoplexy. Some accounts make him to have died in his forty-third, others in his thirty-fourth year.

In 1639 his collected works appeared at Lyons, in thirteen vols. folio. A complete copy of this collection is exceedingly rare. The admirers of Duns Scotus extol his acuteness and subtlety as unrivalled, and he has always been accounted the chief glory of the Franciscans, as Thomas Aquinas has been of their rivals the Dominicans. If in his short life he actually wrote all the works that are commonly attributed to him, his industry must have been prodigious. Duns Scotus followed the great theologian Thomas Aquinas and his friend the mystic Bonaventura. He himself is almost a logical machine. The thirteen folio volumes mentioned contain hardly a poetical image or a superfluous word. Duns the dialectician was succeeded by the last of the five Schoolmen, his pupil and friend Ockham the politician, perhaps more important than all. Duns Scotus must not be confounded with John Scotus Erigena, who flourished a century and a half earlier as the translator of "Dionysius the Areopagite." [See ERIGENA.] From Duns and Aquinas two opposing sects in theology took the names of Scotists and Thomists, and divided the schools, though it is exceedingly difficult to define their differences. Thomas was a conceptualist, Duns a realist, but scarcely more than in word; Thomas an Augustinian, Duns metaphysically, to a certain extent, a Pelagian. But the great source of strife was undoubtedly the firm refusal of the Dominican to recognize the Franciscan pet dogma of the immaculate conception and birth of the Virgin Mary, that not only Christ but his mother also was born of a virgin. This doctrine finally triumphed, and was proclaimed in 1854 by Pio Nono (Pius IX.) as an article of faith.

A very remarkable thing is the derivation of the word *dunce* (ignoramus) from the name of the exquisitely subtle Duns. It arose when the later Scotists set themselves with their hair-splitting definitions against the freer intelligent, religious, and philosophic spirit which succeeded the dark ages; so that after a time a "Dunse" was known as the opponent of all learning and progress.

DUN'STABLE, a municipal borough and market-town of England, in the county of and 18 miles S. by W. from Bedford, and 361 from London by the Great Northern Railway. It is situated in the centre of the Dunstable chalk downs, and is pretty well built. It has considerable straw manufactures. The parish church belonged to a priory of Black Friars, of which it is the only part now remaining. It has recently been thoroughly restored. There are places of worship for Baptists and Methodists, a charity school, and several almshouses. The municipality consists of four aldermen and twelve councillors, including the mayor. The population of the parish in 1881 was 4627. The name is probably derived from the Saxon *dun*, or the British *dunum*, a hilly place, and *staple*, a place of trade.

It appears to be tolerably certain that it was the Roman station of *Magioninum* mentioned by Antoninus in his "Itinerary," as it stands on the junction of the two Roman roads of Watling Street and Ikenield Way. The town, however, appears to have fallen to decay until the reign of Henry I., who cut down the surrounding woods, rebuilt the town, erected a royal palace, founded a priory of black canons, and granted certain immunities to settlers in the town. A fair and market were also granted. At the dissolution the site of the monastery was given to Sir Leonard Champedorpe. In the year 1553 the sentence of divorce between Henry VIII. and Catharine of Aragon was pronounced here by Cranmer. A little way from the town is a mud encampment, such as, Strabo informs us, were made by the ancient Britons. At Dunstable Edward I. erected one of the beautiful crosses which marked the resting-places of his queen's corpse on its progress to Westminster Abbey.

DUN'STAN, ST., was born of noble parents at or near Glastonbury, in Somersetshire, in the first year of the reign of Athelstan, 925. He was carefully instructed in the learning of his time, became a priest, and still early in life was introduced by his uncle, Ælfheah, bishop of Winchester, to Athelstan's court, where he soon became a favourite with the king. He, however, retired to a sort of hermitage at Glastonbury, and here his devotional austerities, his learning, and skill in many manual arts, greatly raised his reputation. According to Robert of Gloucester he was not a very austere recluse, but studied literature and music, and gathered many pupils about him. It was here also that he is said to have had a ludicrous adventure with Satan, whom he seized by the nose with his red-hot tongs for peeping into his cell, a silly tale which it is disgraceful to have to repeat about so great and good a man. Dunstan was made Abbot of Glastonbury by Edmund, Athelstan's successor, and when Edred succeeded his brother Edmund on the throne in 948, he was withdrawn from his retirement and invested with almost unlimited authority by the new king. Dunstan had already rebuilt and restored the Abbey of Glastonbury, and he now imported into England a new order of monks, the Benedictines, who, by changing the state of ecclesiastical affairs, promoting strict celibacy, &c., excited, on their first establishment, the most violent commotions. On the death

of Edred, Edwy his nephew was elected. Upon a quarrel with Edwy about his marriage with a cousin within the prohibited degrees, Dunstan was accused of malversation in his office, was deprived of his abbacy, and banished the kingdom in 957. Edgar, the brother of Edwy, who succeeded in the following year, restored Dunstan to Glastonbury, having promoted him first to the see of Worcester; he then made him Bishop of London; and in 959 advanced him to the archiepiscopal see of Canterbury, and shortly after, when he went to Rome to receive the "pallium" from John XII., he was appointed the papal legate in England. So absolute was his influence that he was enabled to give the Romish see an authority and jurisdiction of which the English clergy had been before, in a considerable degree, independent. The secular clergy were excluded from their livings and disgraced, and the monks were appointed to supply their places. The scandalous lives of the secular clergy furnished one plea for this measure, and it was not altogether groundless; but probably Dunstan's principal motive was that of A'Becket, of increasing the papal power in England. During the whole reign of Edgar, Dunstan acted as his minister, and England was well governed and prosperous. Upon Edgar's death in 975 his influence served to raise Edward, Edgar's eldest son, to the throne. Dunstan continued to rule with absolute sway both in church and state; but upon the murder of Edward in 979, and the accession of his brother Ethelred, Dunstan's credit and influence declined. He died in 988, and his strong firm hand removed, Ethelred "the Unready" plunged from disaster into disaster, until finally he lost the kingdom altogether and the Danes held England. Dunstan's admirers related how angels came to welcome the great statesman on his deathbed; and so many miracles were performed at his tomb that his canonization soon followed his death. A volume of St. Dunstan's works was published at Douai in 1626.

DUN'WICH, a decayed village of England, in the county of Suffolk, but until 1832 a parliamentary borough returning two members, 28 miles N.E. by N. from Ipswich and 99 from London—being 4 miles from the Darsham station on the Great Eastern Railway—situated on the coast of Southwold Bay or Solebay. It was the seat of the first East Anglian bishopric, and in Anglo-Saxon times was a thriving seaport; but the encroachment of the waters has ruined its harbour, destroyed the greater part of the town, and driven the inhabitants inland. It formerly contained twelve churches, all of which have disappeared with the exception of a solitary tower that forms a conspicuous sea-mark—a gaunt skeleton of the past, bearing mute witness to the glory that has departed. Its western face still exhibits the architect's taste and skill; and the fine arch that once faced the nave still displays its lofty outline. Three pointed arches also remain to mark the line of the north aisle. The ruins extant of the ancient priory are scarcely less interesting. Of its palaces and conventual establishments, its hospitals and chantry, there is not a vestige; yet such was the wealth and splendour of the town in the reign of Richard I., that when Ipswich and Yarmouth paid a fine to the king of only 200 merks each, Dunwich paid 1060. In the reign of Edward III. an inundation swallowed up 460 substantial houses. A new parish church was built by subscription about thirty years ago, but the town gives no indication of returning prosperity, and no longer attracts any attention, except from those who visit the coast to study the great natural revolution of which it has been the theatre. Notwithstanding its decay, the borough still has its recorder, bailiffs, aldermen, and common council. Population, 250.

DUODEC'IMALS, a term applied to arithmetical fractions in which each denomination is the twelfth part of that which precedes. Such fractions were once used for the parts of a foot in continuation of the inch.

DU'ODENE is the name of a most ingenious diagram of Mr. A. J. Ellis, introduced before the Royal Society (*Phil. Trans.* xxiii. 3–31), and afterwards published in the additions to his translation of Helmholtz on the "Sensations of Tone" (London, 1875). The use of it is to show the mutual relations of the twelve notes of the chromatic scale of any key in just intonation. Taking C as the keynote, and assuming the usual relationships of the notes of the scale, it is of course at once found that the note A is anomalous. If it is truly a major Sixth from C (and D at the same time is truly a major tone from C) it cannot at the same time be a true Fifth from D. For as the ratio of C to A, a major Sixth, is $\frac{3}{5}$, but the ratio of C to A, which is compounded of the ratios of the major tone C to D ($\frac{8}{9}$) and the perfect Fifth D to A ($\frac{2}{3}$), is $\frac{8}{9} \times \frac{2}{3} = \frac{16}{27}$, it appears that A, the Sixth of C, $= \frac{3}{5} = \frac{81}{135}$, while A, the Fifth of D, $= \frac{16}{27} = \frac{80}{135}$, both being taken in relation with C. As the Fifth, D to A, stands in the scale of C (and as the Fifth from the second to the sixth of the scale in any scale whatever, therefore) it is short of a true Fifth by $\frac{81}{80}$, or what is called in musical acoustics a *comma*. In Mr. Ellis' notation D to A is the false Fifth of the scale, D to † A (the dagger meaning a comma added) would be a true Fifth. But by the same reasoning A♭ will be found to be too flat by a comma for the major Third below C; and the duodene is begun by a line of just Thirds thus, each Third having truly $\frac{4}{5}$ for its ratio. We raise A♭ to †A♭ to get a true major Third below C; and E is left unaltered, as it already stands in the scale as a true major Third from C.

†A♭ C E.

One true Fifth is next taken downwards from each of these, and two true Fifths upwards, and the duodene is complete; thus,

†A

†B♭	D	F♯
†E♭	G	B
†A♭	C	E
D♭	F	A

‡D

D♭ is the true Fifth below †A♭ or "high A♭," it is observed; and †A or "high A" (beyond the duodene) is the true Fifth above D, ‡D or "low D" (also beyond the duodene) being the true Fifth below A. (‡ is the reverse of †, and means that the note so marked is to be *lowered* by a comma.) It is manifest that a duodene can be with the utmost readiness extended as far as is requisite. To get the correctly marked scale of G, for instance, the duodene must be extended one line upwards, the new top line being

†F †A C♯,

and the lowest line of the C duodene being omitted. So also E as a keynote would merely want a row more to the right, made up of pure major Thirds from the present right-hand row, &c. The keynote is always the second note from the foot of the middle row of the duodene.

A student who will patiently extend the duodene into different keys will find its applications remarkably useful. For instance, it is immediately apparent that no two keys are alike, and the difficulties of TEMPERAMENT are thus made manifest to the eye. Thus, to take an example, the three new notes, high F, high A, and C♯, which we have added in forming the key of G, are all notes which have no exact parallels in the key of C, where F, A, and D♭ are their nearest approximations.

The main things to bear in mind in using a duodene is that it never contains true octaves, and that while each row is entirely made up of true Fifths, no two notes of two

different rows (as, for instance, †B♭ and F, or D and A) can be true Fifths. Also it is clear that all the notes on the same line are true major Thirds (as D♭, F, A), all those of the upward diagonals to the left are true minor Thirds (as A, C, †E♭), and those of the downward diagonals to the left are true semitones, with the ratio $\frac{16}{15}$ (as B, C, D♭) &c. In fact, the illustrations are too numerous to be mentioned here, and the reader is referred to Ellis's Helmholtz for more complete analysis.

DUODE'NUM (from a Latin word signifying twelve, because it used to be thought about 12 inches in length), the part of the small intestine in immediate connection with the stomach. It commences at the pyloric end of the stomach, and terminates, at the distance of 8 to 10 inches, in the second portion of the small intestine, called the jejunum. It is in the duodenum that the biliary and pancreatic fluids are mixed with the food, and it carries on the digestion commenced in the stomach. See DIGESTION.

DU'PLICATE RATIO, a term used by Euclid, and defined as follows:—If A be to B in the same proportion as B to C, then the ratio of A to C is called the duplicate ratio of A to B. When A, B, and C are lines, the duplicate ratio of A to B is that of the square on A to the square on B; when numbers, that of A^2 to B^2.

DUPLICA'TION OF CUBE. See CUBE.

DU'RA MATER, PI'A MATER, are membranes which enwrap the brain and spinal cord. The first of these, the *dura mater* (the tough lining), is a tough membrane composed of bundles of connective tissue, which cross at various angles, and in whose interstices branched connective-tissue corpuscles lie. If the skull-cap of the brain-case be removed the dura mater will be seen, rough on its outer surface, cream coloured, following the folds of the brain, supporting it by various processes, containing sinuses to carry off the blood, and sufficiently transparent to allow the veins on the surface of the brain to be seen. It forms the lining or *periosteum* of the skull as well as the outer covering of the brain. The dura mater is firmly attached to the base of the skull, and sends processes through the various *foramina* (orifices) to form sheaths for the nerves as they issue from the brain; then it passes with the medulla oblongata and spinal cord from the skull through the *foramen magnum*, still enwrapping the whole of the brain-substance. The dura mater of the spinal cord differs from that of the brain in being smooth on its exterior, and in *not* being the periosteum or lining membrane of the vertebræ. It sends no processes into the spinal cord, and is in fact a simple tube containing the latter, giving off sheaths to the spinal nerves as they issue from the spine, and terminating in a blind extremity at the coccyx, to which it is attached by a small fibrous process. In fact, therefore, the dura mater as a whole is a long closed bag, roughly comparable to an inverted thermometer-tube in shape, containing brain and cord, and pierced with perforations (whence sheaths project), through which the nerves of the cerebro-spinal system issue to the various muscles and organs.

The *pia mater* (soft lining) lies within the dura mater, and is separated from it by the *arachnoid*, a serous membrane in two layers closely touching the dura mater, but not closely touching the pia mater, and leaving here and there a space filled with the cerebro-spinal fluid, as in the ventricles of the brain. The arachnoid dips down into the great fissure between the cerebral hemispheres, but like the dura mater does not dip into the *sulci* or furrows of the convolutions. It continues along the cord to line the dura mater, and the fluid-filled space (very small in the cord) opens above into the fourth ventricle. The pia mater, on the other hand, closely follows the actual nerve surface of the brain. It is in the brain a highly vascular membrane, dipping down into every furrow, and giving several processes into the interior of the brain, as into the ventricles, &c. It becomes more tough and fibrous as it passes from the skull to line the spinal cord, and soon afterwards almost entirely loses its vascularity.

DURA'MEN, the name given to the central wood or heart-wood in the trunk of a dicotyledonous tree. It is the oldest part of the wood, and is filled by the secretions of the tree, so that fluid can no longer ascend through its tubes, which are choked up by the deposition of solid matter; otherwise it is of the same nature as the alburnum, or sap-wood. It is only where plants form solid hard secretions that heart-wood is distinguished from sap-wood: in the poplar, willow, lime, &c., no secretions of this kind are formed; the two parts of the wood are both nearly alike, and consequently the timber of such trees is uniformly perishable. The chemical changes and secretions taking place in the duramen often give it a very deep colour; thus ebony is the heart-wood of species of Diospyros.

DURANCE, a river of France which rises in the pass of Mont Genèvre, near the source of the Dora Riparia, and has a general S.W. course to Pertuis, thence W. by N. to Avignon, where it joins the Rhone. It passes Briançon, Mont Dauphin, Embrun, Sisteron, &c., and has a total course of 160 miles. It receives a branch from Monte Viso. The upper part of its course is amid mountain scenery of the grandest character. It is very rapid, and navigable only for rafts.

DUR'BAN, a port and county of South Africa, in Natal. The town is situated about a mile to the north of the bay of Port Natal, and is well arranged. It contains several banks and other commercial establishments, a chamber of commerce and agriculture, an agricultural and horticultural society, a custom-house, and several places of worship. Its trade is considerable. Durban was founded in 1834. The population is 14,000.

DUR'BAR or **DHUR'BAR,** a Persian word signifying a house or dwelling, a court or area, and having also the special meanings of an audience chamber, and the court or levee of a prince. The use of the word in this latter sense prevails throughout India; and it has taken its place in the English language, in which it is particularly applied to the state receptions at which the friendly, allied, subject, or protected princes of India pay their respects to the governors of presidencies or the governor-general, or at which they receive these officials or each other.

DU'REN, a town of Rhenish Prussia, situated 18 miles E.N.E. of Aix-la-Chapelle, on the Roer, and on the railway to Cologne. It possesses a gymnasium, a mining school, a blind asylum, and several churches, the last presenting some fine architectural features. The manufactures consist of woollen and cotton goods, paper, needles, iron and zinc goods, soap, leather, and oil. There are also some flax-spinning and felt-weaving works. Population, 17,368. Düren, probably the *Marcodurum* of the Ubii, is surrounded with walls, and has been the scene of many historical events.

DU'RER, AL'BRECHT, one of the most distinguished painters and engravers, was born at Nürnberg, 21st May, 1471. He was the son of a goldsmith, Albrecht Dürer (that is, *Thürer* or Carpenter, doubtless in its origin), who gave him an excellent education, and instructed him in his own art, but at the desire of his son placed him under the most able painter of his native country, Michael Wohlgemuth (1486). After finishing his apprenticeship he set out on his travels, went through Germany, and visited Holland and Italy, where he executed some of his best pictures, such as the "Martyrdom of St. Bartholomew," for the Church of St. Mark, and "Adam and Eve," now in the Pitti Palace at Florence. In Venice he was friendly with John Bellini. In Bologna he became acquainted with Raphael, who esteemed him highly, and in token of their friendship each presented the other with his portrait. Dürer was six years older than Raphael, and twelve years

older than Titian. He returned home in 1507 with the reputation of being the first painter of his country. His industry and perseverance were great, and his productions are numerous; but it is stated that he was unhappy in his domestic relations. The wife of Dürer, indeed, long shared the ignoble honour with the wife of Socrates of having made a great man's life a misery. There is reason, however, to believe that all this tale arose from a certain Pirkheimer, who took offence at the widow after Dürer's death, and revenged himself by blackening her character. Dürer died 6th April, 1528, in his fifty-eighth year. The senate of Nürnberg decreed him a public funeral.

Dürer's paintings are admired for the vividly dramatic and fertile imagination, the sublime conception, and the wonderful union of boldness and correctness of design which they display. He has admittedly one of the greatest names in art, having every great quality except that of grace. His feeling is intense, often to harshness, his workmanship and materials always of superb excellence. Besides his great historical paintings, the best of which are in the collections of Vienna, Prague, Munich, and Dresden, Dürer has left some landscapes that are highly valued. He was also the finest etcher and engraver in copper, and his woodcuts are masterpieces of the art.

Dürer wrote several valuable works on geometry, perspective, and fortification. He bestowed such labour on the purity of his native tongue that his writings even now are well worth the study of the German scholar. Though never adopting the tenets of the Reformation he was a great friend of Luther, by whom he was much respected.

Dürer is far better known by his engravings, drawings, and woodcuts than by his pictures. In the collection published by M. Ephrussi (Paris, 1882) the reader is astounded at the richness and variety of subject and treatment. No other artist, except Holbein and Raphael, has left so many studies. Dürer's favourite method was to draw with colour, with the tip of the brush. The woodcuts in folio books (1511) of the series of the "Apocalypse," the "Great Passion," and the "Life of the Virgin;" the "Little Passion," a set of copper engravings (1512); the wonderful etchings of "Melancholia," the "Knight and the Devil," and "St. Jerome Reading in his Cell" (1513), are known to almost every one by photographic or other reproductions. They are, indeed, among the treasures of art. The Albertina Museum at Vienna has the richest collection of his drawings, and its learned curator (Herr Thausing) has written the best account of Dürer (translated by Eaton, London, 1882); but second only to the Albertina Dürers are those of our own British Museum, which possesses a superb collection of the artist's best works.

Other recent works on Dürer are the careful "Life" by Mrs. Heaton, revised and enlarged in 1883, and Lady Eastlake's brilliant sketch in her two interesting volumes on "Five Great Painters" (London, 1883). Lady Eastlake's painters are—Michael Angelo, Da Vinci, Titian, Raphael; Dürer is the fifth, and though he probably never met Michael Angelo he was the friend of the other three. Truly a remarkable group of contemporaries.

DUR'HAM, an English county, is bounded N. and N.W. by Northumberland, W. by Cumberland and Westmorland, S. by Yorkshire, and E. by the German Ocean. Its greatest length from east to west is 45 miles; its greatest breadth from north to south is 36 miles. The area is 1012 square miles, or 647,592 acres. The population in 1881 was 867,258, an increase of 182,169 since 1871.

Coast, Surface, Hydrography, &c.—The coast of the county of Durham is for the most part low, especially in the detached portions. In the main portion of the county there are several ranges of cliffs, which are of magnesian limestone, except those at Seaton Bents, which are formed of New Red Sandstone. Holy Island, about 4 miles long by 2 broad, is connected with the mainland by a sandbank, which is exposed at low water. The Fern Islands, consisting of several islets or rocks, on two of which are lighthouses, lie a little south-east of Holy Island.

Durham may be characterized as a hilly county. The western part is overspread by the branches of the great Pennine chain, from the eastern slope of which the chief rivers of the county flow. There are several elevations from 1000 to 2000 feet high, and one (Killhope Law) 2196. Large portions of the mountain district consist of moorlands covered with heath. The moors are chiefly used as sheep pasturage.

The Tyne forms the northern boundary of the county for about 18 miles, and it is navigable for about 15. Its Durham affluents are the Derwent, Team, Stanley, and Hedworth. The Wear rises near Killhope Law, and flows through the wild and romantic district of Weardale, past Stanhope, Wolsingham, Bishop Auckland, Durham, and Chester-le-Street, to its junction with the German Ocean at Sunderland. It is about 65 miles long, and navigable for 20 miles. It is crossed at Sunderland by a fine bridge of one arch 236 feet span and 100 feet above the river. It receives numerous streams, all of which are very small. The Tees rises at Cross Fell, in Cumberland, and passes by Barnard Castle, Darlington, and Stockton, to its wide estuary in the German Ocean. Its length is 85 miles; it receives a great number of tributaries, and has many picturesque falls. Among the earliest railways in the kingdom were those of Durham for conveying coals from the collieries to the sea-side. Besides these, there is now a complete network of passenger railways.

Geology, Soil, Agriculture, &c.—The lower part of the valley of the Tees, and the coast from the mouth of the Tees to Hartlepool, are occupied by the New Red Sandstone. The conglomerate limestone crops out from beneath the north-western limit of the red sandstone. This limestone forms a range of round-topped hills along the coast of small elevation. The upper stratum of the limestone is a species of breccia, with which wide chasms or interruptions in the cliff are filled; the next strata are thin and slaty, of a white colour inclining to buff; but lower down the stratification becomes indistinct, the rock is of a crystalline and cellular texture, and of a light brown colour. The brown variety is quarried near Sunderland. A description of the coal-deposit is given in the article COAL. The coal-field of Durham is intersected by many remarkable dykes of basalt and greenstone. It is bounded on the west by millstone grit, the beds of which are estimated to be 900 feet thick. Much of the grit is employed for making millstones. Westward of the district occurs the carboniferous or mountain limestone, interstratified with silicious grit and slate-clay; many of these layers are valuable for building purposes and for making cement. This group is the great depository of the lead veins of the north.

A great part of the county lay at one time in open commons and common fields, most of which are now divided and inclosed. The moors and heaths that remain are chiefly in the poor district westward, and even there cultivation has spread very generally; and the wastes are profitable, in some degree, by rearing a hardy breed of sheep and cattle. The state of cultivation throughout the county is in many parts excellent, and improved implements and better methods of cultivation are readily adopted. Artificial manures are used to a great extent, and draining is well understood and practised. The farms in general are not very large. According to the official agricultural statistics published in 1883, there were 420,000 acres, or rather more than three-fifths of the entire area, under cultivation.

The cattle bred in the county are in high repute, and a great number are annually purchased at the different fairs in this county, and driven northward and southward. The

Teeswater or Holderness breed is the finest of the short-horns. The cows are remarkable for the quantity of milk which they give, as well as their aptitude to fatten. The oxen are considered the most profitable breed for stall-feeding, as they become fit for the butcher at an earlier age than most others. The milkmen near London and other large towns generally prefer Durham cows. The horses bred in this county are of a superior description, both for draught and for the saddle. There was once a very large breed of sheep in the south-eastern part of the county, which bore heavy fleeces, and when killed often weighed from 50 lbs. to 60 lbs. the quarter. But the improved Cheviot and Leicester breeds have nearly superseded them, as being more profitable, and also as fattening at an earlier age.

To the naturalist Durham presents features full of interest, many butterflies and moths, birds, and plants not known elsewhere in England being found in various parts of the county.

Mining, Manufactures, &c.—Durham is one of the chief coal-mining counties in England, and its manufactures, although extensive, occupy only a secondary place. There are about 160 mines, and almost a third of all the coal raised in England is derived from this county. In addition to its coal, Durham produces more lead than any other county in the kingdom, the annual yield being 15,000 tons of ore, containing over 40,000 oz. of silver. There are also some large iron mines, and limestone, millstone, and freestone are extensively quarried. The chief manufactures are in iron—such as iron shipbuilding, engines, and machinery, which are carried on chiefly at Sunderland, Shields, Stockton, and Hartlepool. There are also some large chemical works, potteries, glass-manufactories, paper-mills, breweries, tanneries, and rope-yards. Cotton, linen, and flax are manufactured in some parts of the county, but only to a limited extent; and mustard, woollen and worsted stuffs, carpets, and rugs are also made.

The county is intersected with a complete network of railways, except in the extreme west, and in addition to the passenger lines there are a large number of mineral lines and tramways connecting the mines with the leading railways and shipping ports.

Divisions, Towns, &c.—The county of Durham is a county palatine, *i.e.* a county within which some lord had a jurisdiction "as fully as the king had in his palace;" but an Act of Parliament having some years ago transferred the palatinate jurisdiction from the Bishop of Durham, by whom it had long been held, to the crown, the distinction has been for most practical purposes abolished. The county is divided into the four wards of Chester, Darlington, Easington, and Stockton, and had formerly four outlying districts—Islandshire, Norhamshire, and the parish of Bedlington, which are locally in Northumberland, and the parish of Craike, which is in Yorkshire. The county is in the bishopric of Durham and archbishopric of York. The number of parishes is about seventy, to which are to be added fifteen parochial chapelries. It is included in the northern circuit, and the assizes are held in the city of Durham. For parliamentary purposes it is divided into North and South Durham, each of which returns two members to Parliament, in addition to which two are returned for the city of Durham, two for Sunderland, and one each for Gateshead, South Shields, Darlington, Hartlepool, and Stockton, the three last mentioned having been added by the Reform Bill of 1868.

History and Antiquities.—At the time of the Roman invasion the main part of the county of Durham was included in the territory of the Brigantes. The Romans had several stations in the county, of which two are supposed to have been at Ebchester, on the Derwent, and Binchester, near Bishop Auckland. Roman antiquities have been met with in every part of the county. In the valley of the Wear antiquities of an earlier date have been found, and at Heathery Burn Cave, near Stanhope, numerous bronze weapons and other curiosities have been discovered, preserved under a coating of stalagmite.

In the establishment of the Saxon Heptarchy, Durham was probably included in the kingdom of Deira, the southernmost of the two which are frequently comprehended under the general name of Northumberland. When Oswald, who united the two kingdoms under one sceptre, wished to introduce or rather revive Christianity, Aidan, monk of the Irish mission at Iona in Scotland, who had come as a missionary (634), fixed his residence at Lindisfarn, or Holy Island, and established a monastery and a bishopric there. The bishopric was afterwards removed successively to Hexham, Chester-le-Street, Ripon, and Durham. The ruins of the conventual church still remain: the north and south walls, and great part of the west wall, are still standing; the east wall has fallen in. It has been a very magnificent building, in the Norman style.

William of Normandy, when he conquered the North for the third time (in 1070), took a most dreadful revenge. For 60 miles between York and Durham he did not leave a house standing, reducing the whole district by fire and sword. He did not even spare the churches and monasteries. A famine ensued, and a mortality not equalled in the annals of the country; the inhabitants were reduced to eat the flesh of horses, dogs, cats, and vermin. The lands lay untilled for nine years, infested by beasts of prey, and the poor remnant of the inhabitants spared from the sword died in the fields, overwhelmed with want and misery. The Normans on many subsequent occasions treated the county of Durham with great severity; and in the several incursions of the Scots between the eleventh and fourteenth centuries, Durham, from its vicinity to the border, came in for a full share of disaster.

Durham does not appear to have been the scene of any remarkable event in the War of the Roses. At the time of the Reformation the inhabitants showed a leaning towards Catholicism, which exposed them to much persecution except when Queen Mary was on the throne. During the civil war of Charles I. Durham took but a subordinate part in the king's favour.

DURHAM, a city, municipal and parliamentary borough, and the capital of the above county, is 67 miles E.S.E. from Carlisle, 67 N. by W. from York, and 259 W.N.W. from London, by the North-eastern Railway.

We have no evidence of any town having existed where Durham now stands before the end of the tenth century, when the monks of Lindisfarn, or Holy Island, rested there with the remains of St. Cuthbert. A church was built on the site by Bishop Aldun, and dedicated to St. Cuthbert, whose remains were enshrined in it. The town of Dunholme ("Hill Island"), or Durham, was built around the church, and was soon afterwards well fortified. In 1072 a strong castle was built here, and Walcher, a Norman, was appointed to the bishopric. This prelate purchased the earldom of Northumberland, and assumed the title of count palatine. In 1093 the old church built by Aldun was pulled down, and the present magnificent edifice begun by King Malcolm, Carilepho the bishop, and Turgot the prior.

By the 6 & 7 Will. IV. c. 19 the palatine jurisdiction of the bishops of Durham was taken away, and vested in the crown as a separate franchise and royalty. Before the passing of that Act, the Bishop of Durham, as count palatine and earl of Sedberg, was custos rotulorum of the county; he presided at the assizes with his Majesty's judges, and the sheriff was accountable to him, and not to the king.

Durham is situated on the northern bank of the Wear, which, sweeping round, forms a peninsula, on which the city is built, and the centre of which rises to a lofty eminence, partially inclosed by the ancient walls, and skirted

with hanging gardens descending to the river, on each side of which are delightful public walks called "The Banks." Altogether the town has a most imposing external appearance. The river is crossed by four bridges, two of which are of ancient date.

The cathedral and the castle crown the summit of the rocky peninsula on which the city is built. The former was begun during the reign of William Rufus by Bishop William de Carilepho, and was continued, if not quite finished, by his successor Ranulf Flambard. The cathedral erected by these prelates was of the form of a long cross, with two turrets at the west end, and between them a large and richly ornamented arched door of entrance. The first addition to the original church was the Galilee or Western Chapel, built between 1153 and 1195. The nave was vaulted by Prior Thomas Melsonby, to whom also some ascribe the projecting of the great central tower and the beginning of the building of the Chapel of the Nine Altars. These great works were finished by Richard Hotoun, who became prior in 1290, and who is recorded to have vaulted the choir. The great west window was inserted by Prior John Fossour about the year 1350. The successive additions to this cathedral have rendered the church, as it now stands, not only a perfect specimen of Norman architecture, but an instructive series of examples illustrative of the gradual changes of the English style to the beginning of the fifteenth century. [See the engraving of it in the Plates illustrating ENGLISH CATHEDRAL ARCHITECTURE.] The extreme length of the cathedral is 507 feet; extreme breadth, 200 feet; height of the nave, 70 feet; height of the central tower, 214 feet. The interior of the cathedral was thoroughly restored in 1870–77, under the direction of the late Sir G. G. Scott.

The bishopric of Durham formerly included both Durham and Northumberland, but the latter county was separated from it when the see of Newcastle was established in 1882.

The castle, which once formed an occasional residence of the bishops of Durham, but is now used for the university, was built by William the Conqueror. In the market-place is the guild-hall. The assize courts were remodelled in an efficient manner in 1870. A fine equestrian statue of the Marquis of Londonderry, by Monti, was erected in 1861. The streets are narrow, but well paved and kept very clean. The sanitary arrangements are also very good, and there is an excellent supply of water. There is a subscription library, news-room, and assembly-rooms. The staple trade of the town is in mustard, which is manufactured in very large quantities. There are also iron and brass foundries, and factories for the manufacture of carpets, and for spinning and combing wool.

The city comprises six parishes, each having its church, and there is one district church, and places of worship for various classes of dissenters. There is a grammar-school connected with the cathedral, with four exhibitions, several other schools and charities, a diocesan training school for schoolmistresses, a school of art, and a museum containing a fine collection of British birds. The county hospital is a large and well-arranged building, and there is a well-conducted penitentiary.

The municipal borough is divided into three wards, and is governed by six aldermen and eighteen councillors. Population in 1881, 14,932. The parliamentary borough returns one member. The number of voters is 2400. The municipal and parliamentary boundaries are nearly identical, the population of the latter being 15,372.

Durham University.—In 1831 an Act was passed "to enable the Dean and Chapter of Durham to appropriate part of the property of their church to the establishment of a university in connection therewith for the advancement of learning." By this Act the government of the university was vested in the dean and chapter, subject to the jurisdiction of the Bishop of Durham for the time being as visitor, and the establishment was to consist of a warden or principal, of certain professors and readers, tutors, students, and other officers and persons. In 1884 the university had professors of divinity and ecclesiastical history, of Greek and classical literature, and of mathematics and astronomy. It had also readers of Hebrew, of law, of history and polite literature, of natural philosophy and medicine, and lecturers on chemistry, mineralogy, and modern languages. The management of the university is committed by charter to the warden, a senate, and convocation. Twenty-five fellowships have been founded, some tenable by laymen. The students are lodged in the castle and other adjacent buildings. The University College has a master and vice-master, a bursar and chaplain, and Bishop Hatfield's Hall has a principal and a chaplain.

About 4 miles west of the town is the Roman Catholic College of St. Cuthbert, Ushaw, representing the old college at Douai.

DURHAM, EARL OF (John George Lambton), was born at Lambton Castle, Durham, on 12th April, 1792. He was returned for his native county in 1813, and very soon took a part in the proceedings of the House. In January, 1828, he was raised to the peerage with the title of Baron Durham of the city of Durham. On the formation of the ministry of Lord Grey, in November, 1830, Lord Durham was made lord privy seal; and the preparation of the government Reform Bill was intrusted to four persons, of whom he was one. In 1833 Lord Durham was despatched on a special mission to Russia in favour of the Poles, but it was not attended with any success. His last political undertaking was also his most important—the pacification of the troubles and dissensions of Canada, to which country he was sent out as high commissioner and governor-general, with extraordinary powers, in 1838. He arrived at Quebec on the 27th of May, but a misunderstanding or difference of views soon arose between him and the ministry at home, and he re-embarked from the same port on the 1st of November following. The state of his health now no longer permitted him to take any part in public affairs. In the summer of 1840 he retired, with no hope of recovery, to the Isle of Wight, and he died at Cowes on the 28th of July.

DU'RIO, a genus of which the name has been derived from *durian*, a well-known fruit of the Malayan Archipelago. It belongs to the family BOMBACEÆ. *Durio zibethinus* is a large and lofty tree, with alternate leaves, which are small in proportion to its size; in form they resemble those of the cherry; on the under surface they are covered with round, reddish scales. The flowers grow in clusters on the trunk and older branches. The fruit is as large as a child's head, and has been compared to a hedgehog from its being covered with sharp angular projections. The thick firm rind surrounds a pulp with five cells, each containing from one to four seeds enveloped in a firm edible pulp.

The durian is a favourite food of the natives during the time (May and June) when it is in season; but there is usually also a second crop in November. It is as remarkable for the delicacy combined with richness of its flavour, as for the intolerable offensiveness of its odour, which is compared to that of onions in a state of putrefaction, on which account it is seldom relished by strangers, though highly esteemed by many European residents. The seed, with its edible enveloping pulp, is about the size of a hen's egg; the latter is as white as milk, and as delicate in taste as the finest cream, and should be eaten fresh, as it soon becomes discoloured and undergoes decomposition. Mr. Alfred Russell Wallace is enthusiastic about the durian. In Hooker's "Kew Journal of Botany," he says—"A rich custard highly flavoured with almonds gives the best general idea of it, but there are occasional wafts of flavour that call to mind cream-cheese, onion-sauce, sherry wine, and other

incongruous dishes. Then there is a rich glutinous smoothness in the pulp which nothing else possesses, but which adds to its delicacy. It is neither acid, nor sweet, nor juicy; yet it wants none of these qualities, for it is in itself perfect. It produces no nausea or other bad effect, and the more you eat of it the less you feel inclined to stop. In fact to eat durians is a new sensation worth a voyage to the East to experience."

The seeds of the durian are likewise eaten when roasted, and have something of the flavour of chestnuts. The wood of the tree is valued for many economical purposes.

DUR'MAST is the name given to a variety (Sessiliflora) of the oak, *Quercus robur*, which differs from the more common variety in having the acorns clustered, the clusters with a very short stalk, and the young branches downy. But the important difference is that the wood of the durmast has a smaller proportion of medullary rays (silver-grain) than that of the common oak, and is thus not so useful for cabinet-work. But for constructive purposes the two kinds are about equal. The wood of the durmast is "darker, heavier, and more elastic than that of *Quercus pedunculata*, less easy to split, not so easy to break, yet the least difficult to bend."

DUR'RA. See SORGHUM.

DUR'SLEY, a market-town of England, in the county of and 14 miles S.S.W. from Gloucester. It is a small, irregularly built town, consisting of two streets intersecting each other, and is situated at the base of a steep hill, covered with a fine hanging wood of beech. Some of the houses are of great antiquity. The church is a handsome building, rebuilt in 1866. Near the centre of the town is a neat market-house. The clothing business seems to have been carried on here for a very long time, and there are still some clothing mills in the vicinity. Population of the parish, 5292.

DUS'SEK, JOHANN LADISLAW, a musical composer, was born at Czaslau, in Bohemia, in 1761. He and his brother and sister were all brought up as musicians by their father, the town organist, and himself of some local repute. J. L. Dussek alone, however, achieved any extensive reputation. While yet a boy his extraordinary pianoforte and organ playing made him famous; but the strongly sentimental cast of his mind at this time caused him to seek admission to a cloister. In strange contrast to this, when the Cistercians had refused admission to so young an aspirant, he accompanied Count Münner with his regiment to the Austrian provinces of the Netherlands. Hence he went to Bergen-op-Zoom, Amsterdam, and finally to the stadtholder of the Dutch Republic at the Hague. In 1783, when twenty-two years of age, he visited Hamburg to study under C. P. Emmanuel Bach, and thence, next year, he went to Berlin. After this he travelled through Germany and Poland, staying nowhere long, playing the pianoforte, the organ, and the harmonica. This instrument is the "musical glasses" of the "Vicar of Wakefield." ("The ladies . . . would talk of nothing but high life, pictures, taste, Shakspeare, and the musical glasses.") It consisted of a series of glass bowls, and was a very successful attempt to organize the well-known musical sounds producible by rubbing a wet finger round a drinking glass. [See HARMONICA.] In 1786 Dussek was at Paris, and the then still happy Marie Antoinette strained every nerve to retain so gifted a musician. Italy, Paris, and London next saw him in turn, and in our own capital he first settled down. He remained in London, composing, playing, teaching, and finally publishing, till 1800, when his unbusinesslike habits caused him to have to fly from the creditors of his music shop. It is said that a princess carried him off to a secluded spot in Denmark for the next two years, but this long-credited story is of a rather doubtful nature. In 1803 his intimate friendship with Prince Louis Ferdinand of Prussia began, and the two men were inseparable till the prince's death in 1806. After a short engagement with the Prince of Isenburg, Dussek entered the service of the famous Talleyrand, then recently dubbed Prince of Benevento by Napoleon. He died at St. Germain-en-Laye in 1812.

Dussek's unbalanced character, as indicated in his wandering career, which has been designedly given in some detail, injured his really great talent. He never had opportunities for continuous study, and all his numerous pianoforte compositions lack form and development, beautiful as very many of them are. This is much to be regretted, for the composer of the lovely "Consolation" and the "Elegie" written after the Prince of Prussia's death, was by nature inferior to few in the finer qualities of musical imagination. As Mendelssohn regretfully said, "Dussek was a prodigal." On the other hand, his constant playing and his ardent restless temperament, though they have thus deprived us of great pleasure, in all probability enabled him to excel all his contemporaries in expressive and romantic playing. All contemporary musical writers speak of his wondrous power of "singing" on the pianoforte. Tomaschek speaks, for instance, of "one great Ah! of admiration" extorted from a large audience by a prelude of Dussek's. "There was something magical about the way Dussek touched the pianoforte," he continues; and Tomaschek was a composer of repute. Probably Mozart and Beethoven alone, of all the fine performers living in his time, equalled Dussek as a pianist.

DUS'SELDORF, a government in the Prussian Rhine Province, is bounded N. by Holland, E. by Westphalia, S. by the government of Cologne, and W. by Holland. It has an area of 2065 square miles, and is the most densely peopled portion of the Prussian dominions. About four-sevenths of the inhabitants are Roman Catholics and the rest Protestants. The Rhine, which enters this government near Rheinfeld, divides it into two nearly equal portions, and after receiving several small rivers, quits it near Schenkenschanz, where it is 2300 feet in width. Its principal feeders on the left bank are the Erft and Mörs, and on the right bank the Wipper, Düssel, Ruhr, Emsche, and Lippe. The soil is highly productive in general, but there are many forests and barren tracts in the mountainous districts on the right bank of the Rhine. There are extensive manufactures of woollens, silks, cotton thread, leather, steel, iron, ironware and cutlery, tobacco, soap, &c. Iron, coal, and potters' clay are among the native products. Grazing and the rearing of horses and cattle are actively pursued. The district comprises, in fact, in a comparatively small space, every sort of manufacture to which human ingenuity is applied, while it furnishes in ample quantities the raw material from which machinery and the motive power of machinery are derived. Interchange is favoured by the current of a river the navigation of which is secure for ten or eleven months of the year, and a network of railways only comparable in extent to that of Belgium or Great Britain. The rapid growth of industry is copiously demonstrated by density of population and abundant wealth. Labour, however, which up to 1870 had been comparatively cheap, has been greatly enhanced in value by several strikes which have taken place, chiefly since the war with France in 1871. The efforts of the iron-masters to produce iron profitable at prices proportioned to those ruling in England and Belgium were thus for a time seriously retarded. Protectionist legislation, however, has been repealed, and in spite of all drawbacks the trade has expanded until the production of iron in the Düsseldorf district in 1883 was more than 2,000,000 tons, against 900,000 tons in 1863.

DUS'SELDORF, the capital formerly of the duchy of Berg, now of the above government, is situated at the junction of the Düssel with the Rhine, on the right bank of the latter, 22 miles from Cologne, and with the suburbs

of Neustadt and Rugselburg, has a population of 94,458. It is one of the best built towns on the Rhine, is surrounded by extensive garden grounds, and consists of three quarters, namely, the Altstadt on the right bank of the Düssel, the Carlstadt, and the Neustadt, which are the finest quarters. The streets are broad, planted with avenues of trees, and contain many showy shops. There are five open squares, in one of which stands a bronze equestrian statue of Johann Wilhelm, elector-palatine, the remains of whose palace forms the most remarkable structure in the town. The town had formerly a famous picture gallery, founded in 1710; but the paintings were removed to Munich in 1808, and those it now contains are said to be of little value. It is the seat of a school of painting which has has conferred great benefits upon the manufacturing population. The Düsseldorf School is more than a group of academies, it has a distinct position in art. An exhibition of paintings is held every summer. The other buildings of consequence are—the present palace, where the governor resides; the observatory, town-hall, court of laws, new barracks, theatre, gymnasium, a mint, and public library of about 50,000 vols. Düsseldorf has several churches; the most remarkable are St. Lambert's and St. Andrew's, which contain some good pictures and the tombs of several of the dukes of Berg. There are also a synagogue, several schools, a house of correction, and a lying-in institution in the town.

Düsseldorf is the seat of the provincial government and tribunals of justice. A court of assize has been held in the town for several years, at which trial by jury is allowed in criminal cases. It has manufactories of woollens, cottons, leather, hats, tobacco, jewelry, mirrors, stockings, &c., and carries on a considerable trade in cotton, wool, wines and spirits, colonial produce, coals, timber, slates, and other commodities. It has been a free port since 1829, since which time it has steadily increased in prosperity.

DUTCH AUCTION. See AUCTION.

DUTCH METAL. See BRASS.

DUTCH SCHOOL (of painting). This school began in an offshoot in the fifteenth century from the fine early FLEMISH SCHOOL, the Van Eycks, Memling, and Schongauer, of Bruges. Many examples remain, by Oswater of Haarlem, Jerom Bosch, Engelbrechtsen (of whom a fine example, one of the earliest Dutch pictures in oil, is in the National Gallery), Van Leyden, &c. But not till the seventeenth century did Holland strike out a path of its own, and then it underwent a most remarkable revival in the art of painting. Franz Hals (1584–1666), with his unsurpassed portraits, Rembrandt (1607–1669), one of the greatest artists of all time with the palette or the etching needle, and Bol, Backer, Eeckhout, Fabritius, and Maes, pupils or followers of Rembrandt, form a fine group. Then there are Lierens (1607–1633), "white satin" Terburg (1608–1681), Ostade (1610–1685), Van der Helst (1610–1670), Gerard Dou (1613–1675), Gabriel Metsu (1630–1680), Jan Steen (1626–1679), Meeris (1635–1681), and several other artists of the highest excellence—often deficient in grace, but almost faultless in drawing, and with fine qualities of arrangement and colour. The over elaboration of the texture of garments, hair of the head and beard, grain of the skin, &c., is well known as a prominent characteristic. Wynants, Cuyp (both 1605–1691), Wouvermans (1619–1668), Paul Potter (1625–1654), Ruysdael (1625–1682), Hobbema (1638–1709) Adriaan Van de Welde (1629–1672), and his brother Willem, are a magnificent group of animal and landscape painters. Potter and Cuyp may be said to be at the head of all animal painters. Another group, devoted to architecture, still life, flowers, &c., of which Van der Heyden (1637–1712) for the first, Weenix (1640–1719) for the second, and Van Huysum for the third are pre-eminent, is equally fine in its way. All this great period lies in the latter half of the seventeenth century, or but little beyond it on either side, for in art Holland sank as rapidly as it rose. At present the Dutch painters try to copy as closely the modern dashing French school as four centuries ago they did the early Flemish; they have for nearly two centuries entirely lost all individuality. See also PAINTING, and the articles on the chief of the painters named above.

DUTY is that part of the moral law which works by penalty, the other division being virtue, working by reward. If duties are unfulfilled the penalties guarding them are inflicted; and this whether they are duties owed to the law of the land or any other authority, or duties owed to the eternal right, or both. A thief is punished, if all goes as it should, by the magistrate; but he is also punished by Nature, his character being degraded by his neglect of the duty of respecting the property of others. If he be radically depraved these punishments sink him lower; if he be weak, the material punishment may act evilly by driving him to despair; but if he be radically not depraved, the spiritual punishment, conscious degradation, takes the form of remorse, and works with the material punishment to his amelioration. Much of duty is enforced by social sanction, rather than from the bench or the pulpit; such as the duty of cleanliness, of good temper, of fellowship with ordinary tastes and usages. The penalty is here social ostracism. Social disgrace is also an additional and very heavy punishment to criminals. See ETHICS.

DUUM'VIRI or **DUOVIRI**, the name given to any magistrates of Rome who were elected in pairs for the discharge of any class of duties. The double nature of the consulate, prætoriate, &c., is thus carried to the lower offices. Such were the *duoviri navales* (commissioners on naval affairs), like our "admiralty," appointed in the first attempts at founding a navy during the struggle with Pyrrhus, in B.C. 311; and the *duoviri perduellionis* (commissioners on resistance to the public authority) under the early kings of Rome, and the contemporary *duoviri sacris faciundis* (commissioners on religious observances), part of whose duty was to record and preserve oracles for the general public to consult at their convenience. (The latter duumvirs were afterwards increased from two to ten in number.) Such bodies of oracles were the famous Sibylline books, &c. But those who could afford it usually went to Delphi, &c., for themselves. The *duumviri juridicundo* were the chief magistrates, and the *duumviri quinquennales* were the CENSORS of municipal towns. The foundation of a temple, its dedication, &c., was also generally intrusted to special duumvirs.

DWALE is another name for the Deadly Nightshade. See ATROPA.

DWARF is a technical term employed by gardeners to distinguish fruit trees whose branches spring near the ground from *riders* or standards whose original stocks are several feet in height.

DWARFING TREES. There are various methods of producing this effect, such as selecting peculiar kinds of stocks and grafting upon them. For example, if the pear-tree be grafted upon the quince stock, or the peach upon the plum, their growth is very much retarded, and their ultimate size is comparatively small; the same effect is produced upon all other trees where there is a difference between the tissue of the stock and that of the scion which has been grafted upon it; or if dwarf varieties be grafted upon stocks of a similar constitution, though taller in growth, the former will still retain their original character. Again, if the branches be bent and the flow of the sap in any way impeded, or if a quantity of the fibrous roots be cut away and nourishment more sparingly supplied to the branches, we arrive at the same result. Sometimes trees are dwarfed by very severe pruning. This method is very common among the Chinese.

There is another method of producing dwarf trees, which may be termed accidental—namely, selecting dwarf indi-

viduals and obtaining seed from them; and if this is done through successive generations of trees, a variety may be obtained of a very small size. This is the origin of dwarf roses, sweet-williams, dahlias, and other common cultivated flowers.

DWARFS, or beings of diminutive stature and of human shape, have always possessed great fascination for mankind. In the Greek mythology they figure as the Pigmies (Greek *pugmē*, fist, or, as a measure, the forearm, from the elbow to the knuckles, about 13½ inches). Homer mentions them in the third Iliad dwelling on the shores of Ocean, and with difficulty defending themselves against the cranes in spring-time. This perennial contest between cranes and Pigmies was a favourite myth among the Greek poets, and Ovid and Juvenal adopted it in Rome. Heracles (Hercules) came into their land and found them reaping the corn with axes; they climbed up by ladders to drink out of his cup when he set it on the ground; and Swift took his idea of Gulliver's adventures in Liliput from the attack made by the Pigmies on Heracles as he lay asleep. In two divisions they attacked him, but the hero awaking rolled the whole army up in his lion's skin. Aristotle always contended that there was some truth about the numberless traditions of pigmies, for which he has often been censured; but our latest science would bear him out. Professor Huxley, in the first chapter of his "Man's Place in Nature," copies the pigmy brought to Tyson, the anatomist, from Africa, 26 inches high, and described with drawings by him in an essay read before the Royal Society in 1699. Tyson's pigmy is a chimpanzee, and the locality of that ape, Western Africa, answers sufficiently to the "shores of Oceanus by the pillars of Hercules" (Gibraltar) of the ancients, to warrant the great consensus of travellers' tales which struck Aristotle as containing a meaning.

Far different were the dwarfs who figure so largely in German myths. They are fabled to have arisen thus:—In the beginning was a great abyss, Ginnungagap (the yawning gap or gulf), in which dwelt Allfather the uncreated. The fiery heat of Muspelheim (land of brightness) melted the eternal ice of Nifelheim (land of mist) across the Ginnungagap, and the dreadful giant Ymir came to life, whose children were the Hrimthurses or frost-giants. But also a cow came to life, and licked the salt ice-rocks till she licked them to the shape of a man, and from this man descended Odin and the Ases (gods). The Ases fought with Ymir and flung him into the abyss, which he filled, and from his body they made the earth, from his sweat the sea. Creatures of all sorts crept like maggots in and out of Ymir's body meanwhile. Struck by Allfather with a creating-fever, these the Ases turned into dwarfs or trolls, whom they gifted with a wonderful knowledge of minerals and stones of all kinds, and an extraordinary power of working in metals. But the dwarfs were of two classes: the one fair, good, and useful to gods and men; the other dark, cunning, and treacherous, and by far the more numerous. The first dwell with the Ases in Asgard, or among men to help them; they are the elves and fairies of later fairy story. The second dwell deep in the earth; they are the black dwarfs, often misshapen and ugly, compelled to work for the Ases in their forges and mines, but deceiving them whenever possible, and often enticing men to their ruin. It is quite likely that some prehistoric race, whom the invading Teutons had dispossessed in their western march, and who had retreated into lake-dwellings or CRANNOGS, or into caves and holes, may have been the prototypes of the black dwarfs. Weakly race as they must have been, their resource would be naturally in concealment and cunning, hence their characteristics in story. It was the dwarfs who forged the hammer Miölnir of Thor, and when he swung it round his head the wind he caused was the thunder-roll, and the shine of the golden hammer was the lightning-flash. It was they who forged the good sword Balmung, so famous in the hands of Siegfried, hero of the Nibelungen-lied. Alberich, their king, was ruler and guardian of the Nibelung golden hoard which caused so many brave men to die. Magic swords and caps of darkness are always the chosen wonder-workers of the dwarfs. Another famous legend of Alberich makes him the father of Ortnit, emperor of Lombardy. As the Norse mythology gave place to Christianity it sank into fairy tale, and as such remains to our day in almost pristine vigour. Children now in "Grimm's Fairy Tales" breathlessly devour those adventures of the dwarfs which are the changed remnants of what was once a faith believed in as firmly as the mediæval miracles. Meantime the trickish underground spirit in Nature, yielding only to force, but obeying faithfully those who were strong enough to compel true service, was embodied in the mediæval devil and imps, types of monkish fancy to be seen on hundreds of walls and in thousands of pages.

Dwarfs were favourite appanages at court during the middle ages, and those who had wit enough to be jesters were esteemed almost priceless—but the Gibsons mark the last stage of the fashion in England. In Oriental countries it remains to this day.

Of actual dwarfs some have been celebrated. Such was Sir Jeffrey Hudson, knighted in jest, brought to table in a pie to amuse King James I., &c., described by Sir Walter Scott in "Peveril of the Peak," in his unrivalled manner of giving life to the dry bones of fact. Sir Jeffrey Hudson, when thirty-eight, stood 18 inches high. He lived from 1619 to 1678. Another personage as fully recorded as Hudson, of equally small stature, but of far different mind, was Richard Gibson (1615–1690), who married Ann Stephen, another dwarf. Mrs. Gibson even attained the advanced age of eighty-nine. Gibson lived to seventy-five, had nine children, five of whom grew up and were of ordinary stature. He was an artist of great talent, court-painter (especially of miniatures) to Charles I., his wife being court-dwarf to the queen. At their marriage the king gave away the bride, and Waller, the court poet, wrote the well-known lines—

> "Design or chance make others wive,
> But Nature did this match contrive;
> Eve might as well have Adam fled,
> As she denied her little bed
> To him for whom Heav'n seemed to frame
> And measure out this little dame."

Gibson lived to teach drawing to both Queen Anne and her sister Queen Mary II.

In our own times dwarfs are frequently exhibited for money, or exhibit themselves. A certain Charles S. Stratton, born in 1832 at Bridgeport, Connecticut, United States, took the name of General Tom Thumb, and gained a considerable fortune by means of the celebrated "showman" Barnum. When Tom Thumb was twenty-five, it is curious to note, he weighed 25 lbs. and stood 25 inches—exactly the same thing being recorded of Prince Colobri of Schleswig (1851). Even less in stature than Stratton were some tiny creatures who, after being exhibited as the "Midgets," were married in 1883.

Enough has been said to show that dwarfs are by no means unfitted for ordinary life. They can possess genius like Gibson, courage and pride like Sir Jeffrey Hudson, business capacity like Stratton; they can be faithful partners for life, and can honourably bring up children. They are as a rule healthy, and frequently (as in all the cases mentioned above) long-lived beyond the average. Exactly the reverse is the case in nearly all these points with the feeble, ailing, stupid giants who from time to time appear. Guy Patin, a surgeon of the seventeenth century, relates an amusing and perfectly authentic anecdote as to this. The Empress of Austria had all the giants

and dwarfs of the empire brought together at Vienna for a freak. It was feared lest the size of the giants should terrify the dwarfs, and it was thought better to seek other accommodation for the latter. But the event proved that it was the giants who needed help; for some little delay having occurred they came and begged that this might be speedily arranged, saying, with tears in their eyes, "The dwarfs tease us, insult us, and even cheat and rob us, so that there is no bearing them." As it was not possible to quarter them elsewhere, sentinels had to be posted in the castle to protect the giants from the dwarfs.

DWAR'KA, a town of British India, on the peninsula of Katiawar, Bombay, within the dominions of the Gaikwar of Baroda. As the traditional birthplace and residence of Krishna it is an important place of Hindu pilgrimage. Its permanent population is about 5000.

DWI'NA, NORTHERN, the largest river that falls into the White Sea, originates in the confluence of two smaller rivers, the Suchona and Yug, in 60° 46′ N. lat., 46° 30′ E. lon. The Suchona, a navigable stream flowing from Lake Koubinskoe, and running through the south-west of the Russian government of Vologda, describes a course about 285 miles between that lake and its junction with the Yug. The Yug, flowing down from a morass on the northern slope of the Vologda Mountains, and in the upper part of its course washing the walls of Nikolsk, has a length of about 248 miles. These two rivers unite below the town of Veliki-Usstiug, and form the Dwina. From this point the Dwina flows in a general north-westerly direction through the governments of Vologda and Archangel, and discharges its waters through five arms below the town of Archangel into the Bay of Dwinskaya in the White Sea. Its length is about 700 miles. It is navigable from the close of April to the first week in November for a distance of about 240 miles. It generally flows between high banks, and is on an average 500 or 600 feet in width; at Archangel this width is increased to 4 miles. Soon after it has received the Pinega on its right bank, it forms a number of islands, which extend to its mouth. Its chief navigable tributaries on the right are the Vitshegda, which falls into the Dwina near Kershensko, in Vologda, from which point the Dwina becomes navigable; and the Pinega, which enters the Dwina in the government of Archangel, a little above the town of Kholmogory. By a canal which joins the Keltma, a feeder of the Vitshegda, with the Kama, a large tributary of the Volga, the communication between the White Sea and the Caspian is completed. On its left bank the Dwina receives the Yaga and the Yamza or Emtsa. The tides of the Dwina are perceptible nearly 30 miles above Archangel. The basin of the river occupies an area of about 140,000 square miles. Its waters abound in fish.

DWINA, SOUTHERN. See DUNA.

DY'AKS are a people of Malay origin, constituting the aboriginal inhabitants of Borneo. They are divided into several tribes, and are for the most part grossly degraded and superstitious. Piracy was the common occupation of many of them till it was suppressed by Rajah Brooke, whose district of Sarawak contains what are now the most favourable specimens of the race. They cultivate rice and barter with the Chinese; and since the British occupation of North Borneo in 1882 many efforts have been made, with varying success, to induce these wild inhabitants to settle down to civilized industry.

DY'AS is another name for the PERMIAN system; as the latter name is far the commoner, the system will be treated of under that head. The name *dyas* was given to it because in Germany it is divisible into *two* well-marked groups (Gr. *duo*, two).

DY'AUS, the Sanskrit form of the name of the supreme God, in Greek *Zeus*, whence also *Theos*. Hence also the Latin *Jupiter* from *Zeuspater* (father Zeus), and *Deus* from *Theos*. Dyaus and these other forms come from the Aryan root √DIW to shine (in Sanskrit *dyu*). The Teutonic form is *Tiw*, whence the Old English (Anglo-Saxon) *Tiwes dæg*, Tuesday, the day of the shining god, the god of battles. The French *Dieu*, the Italian *Dio*, &c., come direct from the Latin; but it must not be taken that the Latin comes from the Greek, nor either from the Sanskrit. Probably all the families derive directly from the unknown and assumed primitive Aryan tongue.

The whole idea of supreme deity among the Aryan nations may therefore be said to be expressed by "the shining one," and as it is common to every one of this large family of tongues, it is certainly among the most ancient ideas in the world.

DYEING and **PRINTING** (cotton or calico), the operation of impregnating textile and other substances, such as cotton, wool, silk, jute, linen, hair, skins, feathers, &c., with permanent colours. It is altogether a chemical process, and requires for its proper explanation and intelligent performance an acquaintance with the properties of elementary bodies, and of the laws which regulate their combinations. The art of dyeing was known by the ancients, and practised to a considerable extent by the Egyptians, Phœnicians, Greeks, and Romans. The Jews in the middle ages were the principal people who carried on dyeing. Italy, and especially Venice, for about three centuries almost exclusively practised this art. In England dyeing was for ages confined to the apparent colours produced from vegetable juices, the cloth being merely plunged into the coloured liquid without any previous treatment but scouring. Up to the beginning of the seventeenth century the raw woollen cloths of England were sent to Amsterdam, and there dyed and dressed. Among the chief improvements made by moderns in dyeing is that of the employment of colouring principles derived from the mineral kingdom. Perhaps the earliest examples of bodies of this class that came to be used were iron buff and Scheele's green, which were followed by antimony orange and Prussian blue. The two chromates of lead, chrome-yellow and chrome-orange, were introduced in 1821, and these were soon followed by binoxide of manganese, which yielded a colour known as manganese-brown. The coal-tar or *aniline* colours, derived mediately from a mineral source by the aid of advanced chemistry, extend this list indefinitely to a great many actual or possible tinctorial substances.

The moderns have also become acquainted with many colouring substances derived from the organic kingdoms of which the ancients knew nothing whatever. From the New World many dye woods and drugs have been procured that had previously been totally unknown. Of these logwood, Brazil wood, Braziletto, flavine, Nicaragua wood, orchilla weed, annatto, fustic, quercitron, cochineal, &c., are examples. In like manner new dyeing substances have been discovered in the old continents, and from Africa are procured bar-wood, camwood, and indigo; and from Asia, catechu, aloes, barberry root, indigo, galls, kermes, saunders wood, soorangee, safflower, sapan, red-saunders, turmeric, munjeet, lac, &c.; and from European sources madder (from which many colours are derived), woad, archil, French berries, alkanet, sumach, &c., are obtained.

Colours are not immanent, but the result of the action of light on the substances that give them out. The sunbeam, as is well known, can be resolved by the prism into seven sorts of rays—the red, orange, yellow, green, blue, indigo, and violet; but the actual number of primary colours may nevertheless be infinite. A red substance reflects the red rays only, or in greatest abundance, and so of other colours. The art of dyeing, considered optically, consists in fixing upon fabrics, by means of chemical attraction, substances which act upon light in a different manner from the original surfaces of the fabrics themselves. The dyer should be acquainted with the law of the simultaneous contrast of

colours, whereby he will be able to heighten or subdue the tone of colours on placing them side by side. Colours appear most different as to their optical composition when the complementary (*i.e.* the spectrum-remainder) of the one of them is added to the colour of the other. Thus, put a green band alongside an orange band; the red colour complementary of green being added to the orange will make it appear redder; and in like manner the blue, complementary of orange, being added to the green, will make it appear more intensely blue. Dyeing, as has been already stated, has its foundation as an art laid in chemical science; and Bergman appears to have been the first who referred to chemical affinities the phenomena of dyeing. Having plunged wool and silk into two separate vessels containing a solution of indigo in sulphuric acid diluted with water, he observed that the wool abstracted much of the colouring matter, and took a deep blue tint, but that the silk was hardly changed. He ascribed this difference to the greater affinity subsisting between the particles of sulphate of indigo and wool than between these and silk. The wool was seen to be able to attract the whole of the indigo, while the silk could separate only a little of it. The inference that he drew from this was that the permanence of a colour given to a fabric might be measured by the intensity of this attractive force.

The preparation of fabrics for the dye vat is an important part of the dyer's art. All foreign matters must be separated from the goods, so as to render them more apt to unite with the colouring tinctures to be fixed upon them. These foreign matters are either naturally inherent in the stuffs, or added to them in the spinning, weaving, or other manipulation of manufacture. The ligneous fibres must be freed from the coloured azotized varnish on their surface, from a yellow colouring matter in their substance, from traces of lime and iron, from chlorophyll or leaf-green, and from lactic acid. Alkaline lyes are usually employed for cleaning cloths from these natural and incidental impurities. A weak bath of soda has the property of preparing wool for taking a uniform dye, but it must be well rinsed and aired before being put into the dye vat.

Dye-stuffs, whether of vegetable or animal origin, though susceptible of solution in water, and in this state of penetrating the pores of fibrous bodies, seldom possess alone the power of fixing their particles so durably as to be capable of resisting the action of water, light, and air. For this purpose they require to be aided by another class of substances called *mordants*, referred to in the second part of this article. These bodies may or may not possess any colour in themselves, but serve in this case as a bond of union between the dye and the fabric to be dyed. Mordants occasionally modify the dye by forming with the colouring particles an insoluble compound, which is deposited within the textile fibres. Mordants are a pretty numerous class of substances, which increase as the resources of the dyer's art extend. Among these may be named alum, nitro-muriate of tin, nitrate and acetate of iron, the acetates of alumina and of copper, black-iron liquor, and other chemical compounds having the trade name of bar-wood spirits, plumb spirits, yellow spirits, &c. Such dyes as are capable of passing from the soluble into the insoluble state, and of thus becoming permanent without the addition of a mordant, have been called substantive, and all the others have been called adjective colours. When a mordant is applied to any stuff, the portion of it remaining loosely on the surface of the fibres should be removed, otherwise it is apt to combine with the colouring matter and form an external crust of mere pigment, which would block up the pores and obstruct the entrance of the dye into the interior of the filaments. For this reason the stuffs, after the application of the mordant, are drained, squeezed, washed, and sometimes, particularly with cotton and linen, stove-dried.

Dyeing vats or coppers are heated directly by a furnace or by means of steam conducted in a pipe from a boiler at a distance from the vat. In the first case the vessels are almost always made of copper, only in special cases, for the scarlet and some delicate silk dyes, of tin; in the second case they are of copper, iron, or wood. Madder and indigo vats, when heated by steam, have it either admitted directly into the liquor or made to circulate through pipes plunged into it or placed between the copper and an exterior iron or wood case. Dyeing with heat favours the production of a more uniform colour than dyeing in the cold. Time, also, is thus saved; the ingredients, becoming less viscous, penetrate the fibre more rapidly.

To prepare cotton yarn for dyeing the cotton is soaked in warm water for several hours until thoroughly wet, and next rinsed. The bundles of yarn are then loosed, and each roll of yarn is put upon a wooden pin about 3 feet in length and 1½ inch in thickness, six pins or sticks forming a bundle. If the colour to be dyed be dark, such as brown, black, orange, deep blue, &c., the yarn is now ready for the dyeing operation; but if for light shades, such as pink, sky blue, &c., the yarn must be bleached previous to being dyed. This operation of bleaching is effected by the use of hot dilute bleaching liquor, and by subsequent washing in water slightly acidified, followed by other waterings till all acid is removed.

The preparation of cotton cloth for dyeing has been already alluded to in general terms. It is first steeped for some hours in alkaline lye, to remove oil, grease, dressing, or other impurities it may have contracted in the weaving, and what may adhere to it from natural causes; it is then thoroughly affused with clean water. When there is a dash wheel it should be used for this washing.

Silk is scoured by means of boiling in soap and water, whereby it is freed from a sort of natural gum or varnish; if intended to be very white, it is bleached by humid sulphurous acid.

Wool is first washed in running water to separate its coarser impurities; it is then deprived of its *yolk* (a species of animal soap secreted from the skin of the sheep), either by the action of ammoniacal urine, by soap and water, or by a weak lye of carbonate of soda or ammonia; aqueous sulphurous acid, or the fumes of burning sulphur, are employed to give it its final bleaching. Wools present remarkable differences in their aptitude for combining with dye-stuffs, which depend upon the different structure of the imbrications of the filaments.

It would greatly exceed the limits of this article to attempt to specify the scores of receipts known to the trade for producing colours on cotton, silk, and wool, or on combinations of these textile substances. The following list of dyes and colouring substances which produce them may prove useful:—

Red.—Cochineal, kermes, lac, madder, embracing several of its derivatives, archil, safflower, Brazil wood, logwood, periodide of mercury, alkanet.

Yellow.—Quercitron, weld, fustic, annatto, turmeric, Persian berries, willow, peroxide of iron, chrome yellow, sulphide of arsenic, hydro-sulphide of antimony, &c.

Blue.—Indigo, woad, Prussian blue, turnsole or litmus, logwood with a salt of copper, orceine, &c.

Black.—Galls, sumach, logwood, walnut shells and other vegetables which contain tannin and gallic acid, along with ferruginous mordants, &c.

Green.—Combinations of blue and yellow dyes, chrome green, Scheele's green, fustic with Prussian blue, Chinese green, &c.

Orange.—Annatto, and mixture of red and yellow dyes; subchromate of lead.

Brown.—Catechu, manganese, varying proportions of logwood and Lima wood.

Fawn.—Walnut rinds, sumach, henna, sandal wood.

Purple.—Purpurine from madder, sumach with red spirits and logwood, murexide (very unstable)—using for silk corrosive sublimate as mordant; and in dyeing cotton or wool a double chloride of tin and ammonium.

COAL TAR OR ANILINE DYES.—Coal tar has been made to yield, by more or less direct processes, a variety of valuable dyes, many of which are remarkable for their beauty and intensity. The principal dates in connection with them are—the discovery of mauve by Perkin in 1856, of the arsenic process of manufacturing magenta by Medlock in 1860, of the diazo-compounds by Griess in 1864, and of artificial alizarin by Perkin, Graebe, and Liebermann in 1868. Artificial alizarin has now almost entirely supplanted madder. The annual value of manufactured coal-tar colours is about £3,000,000.

Most of the colours under consideration can be brought into solution for dyeing purposes by treatment with weak alcohol or glycerine, or some convenient acid; water is frequently sufficient, even for the more sparingly soluble ones. Some of the early discovered and almost insoluble dyes have been abandoned, their place being now occupied by what are called "sulphonic" soluble derivatives. The more stable colours are in general characterized by considerable chemical complexity.

The experience of dyers has conclusively shown that, in many cases, coal-tar colours require no mordant. Wool and silk, if carefully cleansed, readily combine with them as a whole, according to the ordinary laws of chemical change; cotton, on the other hand, hardly attracts them at all. In the two former cases the usual vat practice is to immerse the goods in a very weak solution of the dye, at from 50° to 90° C., work well, and allow them to remain until sufficiently tinged. The temperatures should be kept as low as possible, in order to avoid the dissociation of the colour which is now known to take place. When the colour is naturally deposited with otherwise uncontrollable rapidity, a small quantity of some retarding agent, such as sodic or magnesic sulphate, is added to the bath. In some cases, such as that of Nicholson's blue, the goods are worked in an alkaline colourless solution of the dye, which is afterwards developed by souring. In the treatment of cotton various mordants are used; but the most efficient is antimonious oxide, deposited from a solution of emetic tartar. In dyeing and printing with alizarin, the old madder processes are still in substance employed, the artificial dye taking the place of about one hundred times its weight of madder. Some particulars as to the more important of the coal-tar colours are recorded below.

Yellow.—Picric acid, or trinitrophenol, gives a fine yellow tint with a greenish shade; it is chiefly used to modify other colours. Martius' yellow is prepared from naphthalin, and has a much purer golden tint. Chrysaniline has somewhat of an orange shade. There are many other yellows, chiefly nitro-compounds.

Red.—Of these the commonest is magenta, itself colourless, but whose salts have a purple-red tint. It is not now much used alone, but more often in association with other colours; and is itself the starting-point for the manufacture of a whole series of tinctorial derivatives. Saffranine is a beautiful, but rather fugitive rose-red, soon fading in strong sunlight. It is much used in calico printing, with a stannous mordant, and for giving a finish to poor qualities of Turkey-red. Aurine and coralline, allied reds of a crimson character, are also frequently employed. "Biebrich scarlet" and croceine are diazo-compounds, fast and beautiful scarlets, in great request for wool and carpet dyeing. This class of compounds represents the most recent direction of organic research as connected with dyes.

Blue.—The fastest blue is perhaps triphenylrosaniline or "opal" blue, now for the most part superseded, on account of its insolubility, by Nicholson's blue, which is prepared from it by the action of strong sulphuric acid; the latter, however, is a fairly fast colour, very often used as a substitute for indigo or wool. Hoffmann's "violets" have long been popular among dyers; they are ethyl-derivatives of magenta, and red to blue as their ethylic constituent increases. Mauve, or aniline violet, is prepared by oxidation processes from pure aniline salts; it is now in but small demand, and only employed for blending or toning. Other blues, of more or less modified tint, can be made by acting with ethylic iodide on mauve; or, directly from aniline, by some variation in the process of oxidation. Indophenol blue, recently introduced by Witt, is employed as a substitute for indigo. It gives a good fairly pure blue on wool, but is much more employed in calico printing than in dyeing. While much resembling indigo in its application and treatment, it differs in its constitution much from that substance, being the result of oxidizing certain paradiamines in presence of a phenol or naphtol; the latter method gives the fastest shades.

Green.—This colour is often produced by simultaneous or alternate dyeing with blue and yellow. Of "self-greens," aldehyde green and Hoffmann's (or iodine) green are in most request. Aldehyde green is very brilliant, but somewhat unstable, and therefore generally made as required. It is prepared by treating sulphate of magenta with aldehyde and sodic hyposulphite in succession, and principally employed as a silk dye. Hoffmann's green is an ethyl or methyl derivative, and a good deal used by the printer. The greens are the least numerous and the least stable of the aniline colours.

Brown.—The only brown of importance is "Bismarck" or phenylene brown. It readily dyes wool and silk, a soap-bath being used in the latter case. It is not very fast under washing. There are various other browns of less definite composition, but all more stable, on the whole, than the greens.

Black.—Aniline black is perhaps the most satisfactory in point of stability of all the coal-tar colours. On a small scale it is sold as a marking ink under the name of jetoline. It is not applied to wool or silk, but is to some extent in request as a dye for yarn. In this case the first bath consists of a ferrous salt, in which the goods are dipped and then wrung and aired; they are then immersed in an acid mixture of chlorate and aniline salt, heated to 70° C., wrung out and aired. Blacks developed below 70° C. are apt to "go back," as it is termed, and become greenish. For calico printing, pastes having an extensive range in point of composition are printed on by the machine. All of these contain, in addition to the usual thickener, pure hydrochloride of aniline and some agent intended to "carry" oxygen from the air. Cuprous sulphocyanide is very commonly employed as a "carrier;" sometimes a mixture of this or some other copper salt with vanadic acid or ammonic vanadate, sometimes vanadate alone. In the last method, which probably gives the best results, about a grain of vanadate is added to a gallon of paste, and the black, after development at 70° C., is enriched by a passage through a chamber into which ammonia vapour is freely delivered. The whole process of developing only requires a few minutes. Aniline black is scarcely attackable by ordinary chemical reagents, and remains uninjured when soaped, even severely.

There are a number of other aniline or coal-tar colours all more or less interesting, and some of them having special peculiarities. Eosine, for instance, contains a large quantity of bromine, and is most remarkable for the *play* of colour it exhibits. It is in considerable demand, in spite of its rather fugitive character, both as a paper-stain and a dye, being frequently used in the latter capacity to give a bloom to other colours. "Vermilionette," a cheap substitute for vermilion, is merely red lead stained with this elegant dye.

The beautiful colours which Mr. Greville Williams prepared many years ago from cinchonine oil deserve a passing notice here, but are now only of historical interest. The bases contained in bone oil will, it is probable, ere long be utilized as sources of dye.

PRINTING COTTON OR CALICO.—This is the art by which, through colours and variations of tint, artistic and other ornamental forms are impressed or stencilled on cotton cloth. This name is now extended to signify the employment of coloured designs for the decoration of all sorts of woven fabrics—calicoes, muslins, linens, silks, or woollens, or of the many mixed varieties composed of different textile materials. The art of calico printing, it may be inferred from Pliny, must have been known to the ancient Egyptians, who were skilled in dyeing cloth of various shades in the pattern by one operation of the dye bath. It has been practised from time immemorial in India, where also the use of woodcuts with resist pastes for forming any desired figures or spots on the cloth has long been common. The Chinese employed block-printing long before any species of printing was known in Europe, and processes of printing on cloth similar to the Indian and Chinese have long been practised in Asia Minor and the Levant. Augsburg was famous for its printed linens and cottons towards the close of the seventeenth century. About the year 1690 calico printing was commenced on the banks of the Thames, at Richmond, by a Frenchman. The art was first practised in Scotland in 1738, twenty-six years previous to its introduction into Lancashire, where in 1764 Messrs. Clayton of Bamber Bridge, near Preston, carried it on. Roller printing became a practical success with the introduction of Bell's machine in 1785.

Calicoes, muslins, &c., intended for printing are first of all freed from their fibrous down, on the side to be printed, by the action of the singeing machine. This consists of a semicylinder of iron or copper laid horizontally, and kept at a cherry-red heat by a furnace or a range of non-luminous gas-jet flames. The cloth is drawn over this hot metal surface with a steady continuous motion, and at a rate suited to its texture. The cloth is next well bleached, because the whiter it is the more light it will reflect from its surface, and the more brilliant will be the colour of its dyes. The goods are next rinsed, dried, and bleached.

There are four methods of printing figures or designs on calicoes or other cloth: first, by small wooden blocks worked by the hand, on which the pattern is cut or otherwise produced *in relief;* second, by larger wooden blocks, also in relief and combined in a frame; third, by flat engraved copper plates; fourth, by engraved copper cylinders.

The hand blocks, which from being formerly made of sycamore wood with the pattern cut out upon them in relief, have as a later improvement the pattern raised on the surface of a plain block, by pieces of flat copper or brass wire of various thicknesses and forms, produced by drawing the wire through dies of different thicknesses and shapes. These pieces of wire are forced into the wood at the traced lines of the configuration by the taps of a hammer, and the external surface of the block is then filed flat. Still later, stereotyping has been applied to the production of printing blocks. A mould is first taken from a model, and from the mould fixed in a block copies are produced in the common stereotype metal.

Calico printing by the hand is performed by applying the face of the block to a piece of woollen cloth stretched over a sieve-hoop or drum that, by means of a flat brush, has been imbued with the colouring matter of a thin pasty consistence. The block is then applied to the surface of the cotton cloth while extended upon a flat table covered with a blanket, and the impression is transferred to it by striking the back of the block with a light mallet. Every time that the workman presses his block upon the sieve in order to charge it with colour, it becomes the duty of an assistant to brush over the woollen surface in order to erase the mark that the pressure had previously made on it, so that the block may be evenly charged with colour for the next operation.

Printing Different Colours with one Block.—If the pattern contain five or more colours there must in general be as many blocks as there are colours, all of equal size, the raised portions in one of which take up colour corresponding with the depressed portions in the others which do not. Considerable improvement has been made upon this method of printing simultaneously different colours with one block. By this plan three or more oblong blocks are laid side by side, and are imbued with different colours all at the same time from a trough arranged for the purpose. The hand block has now to a considerable extent been superseded in France and Belgium by an apparatus called the Perrotine, which was introduced in 1834 by its inventor, M. Perrot of Rouen. This machine is rather complicated, and very ingenious in construction. In operation it presents three thin wooden blocks, engraved in relief, about 3 feet long and from 2 to 5 inches broad, that are successively brought to bear on three of the four faces of a prismatic roller of iron, round which the cloth is successively wound. Each block rests on springs, which enable it to press with the delicacy of a skilful arm, and each receives its peculiar coloured paste from a woollen surface imbued by a mechanical brush in rapid alternation. The cloth advances to be printed by a length exactly equal to the breadth of the block, and with it the endless web and the blanket, so that the portion of the fabric which leaves the third block behind is fully printed; that which was under the second advances opposite the third; that which was under the first moves along to the second; and a fresh breadth of the white or unprinted fabric arrives opposite the first. In 1844 M. Perrot improved his machine so that it could print four colours. Two men could print with the perrotine from 1000 to 1500 yards of calico daily—an amount of work which with the ordinary block would require twenty-five printers and as many juvenile assistants.

Cylinder Printing followed copperplate printing in the order of time, and was a vast improvement upon the latter. The flat plate used formerly appears to have suggested the cylinder. The latter consists of a very thick tube of copper, ordinarily about 3 feet long and 3 or 4 inches in diameter, the surface of which is engraved, partly by hand graver, but mainly by the mechanical pressure of a steel roller on which, by means of a *die*, the pattern had been previously impressed. The die is itself a short steel roller, which is softened before being engraved in intaglio; it is then hardened and made by a powerful press to transfer its design in relief to a similar die, called the *mill*, which is the one used for transferring the design to the copper cylinder. Sometimes the die is cut on the plate, and the pattern is transferred in relief to the mill; in other cases the die is cylindrical, and the mill flat. Part of the pattern is frequently produced by etching with nitric acid; in such cases the polished steel cylinder is covered with a thin coat of wax or varnish to prevent the action of the acid, except where the surface has been acted on by a diamond or steel point in delineating the design. The electrotype has also been used for producing designs on the printing cylinder.

The single cylinder, or one-colour machine of the French, will afford in its main outlines the simplest illustration of this advanced method of calico printing. The cylinder or roller bearing the engraved pattern is sheathed upon a strong iron shaft or arbor carrying a toothed wheel at its end, in order to make it gear with the other parts of the machine, which with it are mounted on a steadfast iron frame. The cylinder revolves in contact with another

cylinder or drum above, and with a colour roller, covered with a blanket, which is partly submerged as it turns in a colour box below. From this source the engraved cylinder is supplied with an abundance of impressible colour, and is cleared from superfluity by the thin edge of a flat steel blade called vulgarly "the doctor" (Lat. *ductor*). The cylinder, as it escapes from this wiping implement, acts upon the calico, which continues to pass between it and the pressure drum above, and to which some spring is given by a layer of old goods and blankets between it and the drum. Another similar blade, called the "lint doctor," is generally placed on the other side of the cylinder, to remove any fibres that may adhere to it through contact with the calico. The drum may have its pressure increased or diminished by means of bevil gearing or the operation of screws. So also the coloured trough may be raised or depressed by screw action. The unprinted cloth is given off from a large bobbin, fixed at an elevation on the machine, and is stented or stretched in its course to the printing cylinder, whence it is led off into a drying chamber, within which it traverses a series of rollers, and is finally wound on a drum in a perfectly dry condition.

Where several or many colours are introduced, greater complexity of structure is, of course, given to the machine. The French four-colour apparatus of this kind presents each of the engraved cylinders as containing only a part of the pattern to be printed; and supposing the colours in the pattern to be red, blue, yellow, and lilac, one cylinder carries the red, another the blue, the third the yellow, and the fourth the lilac. Each cylinder has under it its own doctor, roller, and colour trough, and all the four cylinders are distributed around the under half of one large pressure drum common to the whole.

The preparation of the colours and mordants for calico printing, as this art is now carried on, demands a large amount of chemical knowledge. Calico printing is a species of topical or surface dyeing, and in this process dye-stuffs capable alone of imparting fast colours to calico have been called *substantive*, and such as require the intervention of a mordant *adjective* colouring principles. Indigo, catechu, and certain metallic oxides belong to the former class; madder, cochineal, and Persian berries to the latter. The mordants, the principal of which are acetate of alumina and acetate of iron, albumen, and lactarine, are first applied to the calico by means of wooden blocks, copper plates, or cylinders, upon which the requisite patterns are engraved. When albumen is used as a mordant, this is fixed by exposure to a steam heat. The cloth is then passed through the colouring bath, and afterwards exposed to bleaching, or is washed. The colour flies from those parts which have not received the mordant, and is permanently retained on those parts to which the mordant has been applied. Sometimes the mordant and colour are printed together, and then fixed by steaming. When the cloth has been subjected to the action of steam, the colour and albumen or mordant mixed with it are rendered insoluble, and remain fixed on the fibres of the stuff.

The art of thickening mordants, or of giving them the consistence necessary to render them fit for different sorts of printing, is an important section of the art of the calico printer. Without thickening the colour would otherwise run or flow, and the patterns would lose their regularity and sharpness of outline, assuming both different shapes and shades. The substances used as thickening must not dispute with the cloth the power of uniting with the colouring matters, otherwise, on removing the thickening, the colour would also disappear. The materials usually employed are starches, various gums, and mixtures of gums with other substances, such as gum-senegal with pipe-clay, salep, glue, &c.

There are seven different styles or processes of calico printing, each requiring methods of manipulation more or less peculiar to itself:—1, The madder or chintz style; 2, the padding style; 3, topical style; 4, resist or reserve style; 5, discharge style; 6, China blue or pottery style; 7, the mandarining style.

In producing the madder style the first process is that of printing on the white cloth, either with the block or machine, one or more mordants, "sightened" with some fugitive colour and of the desired pattern. The kind of mordant will depend on the colour which it is desired to produce in the dye-beck. The cloth, after being mordanted, is pretty quickly dried, and is then exposed to a warm moist atmosphere, or *aged* for some time, and next *dunged*. This latter process is important, and demands great care; it consists in drawing the goods through a solution of cow-dung, or else through dung substitute, or sometimes, for delicate colours, through a bran-bath, whereby a part of the undecomposed mordant is separated from the cloth, and some of the superfluous thickening materials are dissolved and removed. The mordant is, besides, more strongly fixed in the texture by uniting with some of the constituents of the dung or of its substitutes. On being removed from the dunging-bath the cloth is rinsed, and the desired colour is then brought up in the madder dye-bath, the tinctorial matter attaching itself permanently only to those parts of the cloth on which the mordants have been applied; artificial alizarin, however, is now invariably used instead of madder.

In the second or padding style of printing, the whole cloth is first imbued with a mordant by padding, and sharply dried; the different coloured figures are afterwards raised by the topical application of other mordants joined to the action of the dye-bath, or the cloth may be first printed with one or two saline solutions, and be afterwards padded uniformly with the other. To produce a ground of Prussian blue, the goods may be padded in a solution of acetate and sulphate of iron, and afterwards winced in a solution of yellow prussiate of potash. Or to produce a design or pattern in the same colour, the cloth is printed with the mixed solution thickened with gum, and after being aged it is winced in chalk-water, cleaned, and then winced in a solution of prussiate of potassa. For a chrome yellow the pad should be acetate or nitrate of lead, and the solution bichromate of potash. Iron, buff, or chamois, manganese bronze, chrome orange, and other mineral colours, are applied in the same manner either for grounds or designs.

The third or topical style, for spirit and steam colours. This distinction rests upon the circumstance that the colours are applied topically, or on the surface, and are printed on the cloth along with the mordant, and are afterwards fixed by exposing the cloth to steam. The use of albumen as a mordant is an example of this; when it is coagulated by the steam heat, the colouring matter mixed with it is thereby attached to the cloth. The reason for this process is founded on the fact that some dye-stuffs, such as indigo, annatto, and safflower, are either of themselves insoluble, or but slightly soluble in water, and therefore cannot be applied by the common maddering process. When these or their alkaline solutions are formed into a paste and printed on the cloth, some of them acquire a certain fixity by mere exposure to the air, others require that they should be imbued with a mordant, and subjected to the action of steam. A considerable variety of colouring substances admit of being fixed by this latter process, and are thence called *steam colours*. All fugitive topical colours not fixed by steam are called *spirit* or *fancy colours*. These latter are produced by mixture of vegetable dye extracts and solutions of tin, commonly called spirits by dyers. *Spirit chocolate* is produced by extracts of Brazil wood and logwood, chloride of tin, and a little nitrate of copper—all mixed, thickened, and merely printed

on. A *spirit red* is given by extract of peach-wood and tin, with a little nitrate of copper. Prussian blue is prepared for topical printing by grinding in a mill for the purpose, and triturating the powder with a solution of chloride of tin; it is then thickened and printed on the cloth. There are several kinds of steaming apparatus employed in this sort of work, generally called the cask or drum, the chest, the lantern, and the chamber, which are so many receptacles for the cloth after it has passed the printing machine and received the colours to be fixed on the fabric. The operation lasts twenty or thirty minutes.

The fourth style of colouring, called the resist or reserve style, signifies that the whole surface is impressed with figures in a resist paste, and is afterwards subjected to a general dye, such as the indigo vat. The paste is afterwards dissolved off in a hot or acid bath; the effect produced is that of white or coloured patterns on a blue or otherwise coloured ground. There are two great kinds of resists—mechanical and chemical; the first named are chiefly of an unctuous nature, or substances having for their base resins, fatty bodies, or essential oils, and are used for silks or woollen goods. The chemical resist pastes are various; one consists of nitrate and subacetate of lead, acetate of copper, gum, and pipe-clay; a second of acetate and sulphate of copper, acetate and sulphate of lead, and gum; a third of pipe-clay, corrosive sublimate, gum, and olive oil. The resist paste is generally printed on the cloth by a cylinder machine; the cloth is then died in a bath, and cleaned and brightened by subsequent processes.

The discharge style, or fifth in the series, relates to the application of a substance called a *discharger* to the already dyed or mordanted cloth. Various coloured figures or patterns are, on this plan, produced by discharging portions of the ground, attention being given to the chemical relation between the ground and the discharger. The pastes used consist, in one example, of oxalic acid, tartaric acid, lime juice, pipe-clay, and gum; another, of a nitro-muriatic solution of tin, thickened with wheat flour; another consists of lime juice, tartaric acid, nitrate of lead, pipe-clay, and gum. On washing the fabric, or passing it through chloride of lime solution, that part only of the ground colour remains which has not been printed over with the paste. Dischargers for mordants must be such as shall be capable of combining with the metallic oxides which constitute the bases of these mordants, while at the same time the combination so formed shall not itself act as a mordant. Three organic acids—the tartaric, the citric, and the oxalic—are chiefly employed for this purpose.

The China blue style, or sixth in the series, is practised only with indigo, the pigment being printed on the cloth in its insoluble state, and dissolved into the texture by the successive application of lime and protosulphate of iron with exposure to air. According to this process the insoluble indigo is first printed on the cloth mixed with certain ingredients, such as indigo, orpiment, sulphate of iron, gum, and water; and then it is reduced to the soluble state and washed into the pores of the stuff by a series of alternate immersions in alkaline and iron solutions. Different shades of blue are by this means dissolved upon the fabric, so as completely to penetrate its texture without intermixing with each other. For a pattern in China blue to consist of one, two, three, or any number of these shades associated with white, the proper shades are selected, and the colour, suitably diluted and thickened, is printed on the stuff with a separate block or cylinder for each shade.

Lastly, there is the style of *mandarining*. The chief feature of this so-called style is that of communicating a yellow or orange colour to goods by exposing them to the action of nitric acid. This is practised only on silk and woollen stuffs.

These distinctions of styles are to be understood as marking strong, rather definite, distinctions in this great art—as pointing at so many prevailing features which are sometimes blended and subdued more or less in single examples. The madder or alizarin style is still the most extensively practised, and may be regarded as affording the most varied illustrations of the art.

DYER, JOHN (1700–1757), is remembered in English literature by his excellent poem in eight-syllabled verse "Grongar Hill," published in the same year as Thomson's "Winter," and proving a not altogether unworthy rival (*longo intervallo*) in the reviving school of natural observation. Dyer's longest piece, "The Fleece," is in four books in heroic metre, and has for subject the tracing of the wool from the sheep's back to its operation as an article of commerce upon the world.

"To censure trade
Or hold her busy people in contempt
Let none presume,"

is his theme. Dyer's verse well repays the reader; much genuine poetry is obtained from the simple themes he chooses. He was by profession a clergyman of the Church of England (rector first of Belchford, afterwards of Coningsby, Lincoln), and his life was altogether uneventful.

DYKES (Dutch, *dyk*), artificial mounds raised by the sides of rivers or along the sea-shore in order to prevent inundation. The term *levée* is used in France to signify this species of embankment, of which the levées of the Mississippi near New Orleans afford a good example. A dyke must be of sufficient breadth and height to resist the water, and should be made with an easy slope, to allow the flood to rise without any particular impediment. The Dutch have long been distinguished for their ingenious system of dyking; by no people has the erection of dykes been carried to such a length. One of the most gigantic of these dykes is that along the Helder. It measures about 6 miles in length, is 40 feet broad at the summit, along which there is a good road, and descends into the sea by a slope of 200 feet, inclined about 40 degrees. The cost of keeping these works in repair is however very great, and only their absolute necessity for the safety of the country could have induced such vast expenditure of labour and money.

DYKES are more or less vertical sheets or walls of rock traversing rocks of a different nature. Intrusive sheets of a similar nature, but more or less horizontal, are spoken of as *veins*. Dykes are frequently more parallel-sided and wall-like in structure than veins (the word dyke being the north-country word for *wall*), but neither this characteristic nor their greater inclination to the horizontal justify their separation; their origin and character are the same. Some writers, indeed, treat of both as *dykes*, using the term *vein* to denote a mineral lode. Dykes are generally formed by the intrusion of molten rock into the rents and fissures in other rocks, the molten rock solidifying, and being easily distinguished from the surrounding rock by its difference in texture and composition. These intrusive sheets cut not only through stratified and metamorphic rocks, but even through other igneous rocks. Thus dykes of pegmatite and elvanite are found traversing granite; sometimes veins of granite are found cutting into large masses of granite, the texture of the vein being generally finer in grain than that of the surrounding rock in this case. Intrusive granite masses often send out branches and sheets in all directions into the surrounding rocks.

All the commoner eruptive rocks, such as diorite, granite, felsite, diabase, basalt, &c., occur as dykes and veins. Sometimes the rock composing the dyke is harder than the surrounding rock, and as the latter wears away, stands out like a wall; occasionally the reverse is the case, and deep trenches mark the removal of the material of the dyke by denudation. The vertical walls of Val di Bove

(Mount Etna), standing out from the soft tuff cones, are excellent examples of the former phenomenon, while the coasts of the Inner Hebrides and Clyde Islands afford examples of both. In some parts of the west of Scotland the dykes stand up so prominently from the ground that they are used as inclosures.

Dykes vary in thickness from an inch or two up to 30 or 40 feet. Sometimes they extend for a few feet, at other times for many miles. In Yorkshire there is a large dyke running across the county for 60 miles, and ending on the coast. The south-west of Scotland is traversed by a series of parallel basalt dykes, running north-west and south-east for 20 or 30 miles. The eruptive rock composing them was ejected by volcanoes in the Miocene epoch, a period of great volcanic activity in north-western Europe. Lundy Island, which is probably the remains of an old Miocene volcano, is traversed by repeated dykes, and affords an interesting and readily accessible example of a dyke-traversed district. Cornwall abounds in dykes, some of great thickness and extent.

As may be imagined, sheets of molten rock, such as subsequently solidify to dykes, cannot be intruded without to some extent altering the surrounding rock in immediate contact with them. As a matter of fact we often find considerable changes thus wrought. Clay becomes baked to enamel like *porcelainite*, sandstones become quartzites, silicious schists become Lydian stone, chert, and hornstone, clay slates are changed to chiastolite-schist and mica-schist, graywacke to mica-slate and gneiss, coal and lignite to anthracite and graphite, limestone to marble, &c. Nor does the dyke itself escape change. The outer walls in contact with the rock into which the molten mass is intruded are, of course, quickly cooled down, and we accordingly meet with the usual results of the rapid cooling of an igneous rock. A crust of glass, of greater or less thickness, coats the dyke in many places—a felsite dyke showing a crust of obsidian or pitchstone; a basalt dyke, of tachylite or hyalomelan. Dykes are also, as a rule, finer grained near the edges than at the centre, the larger crystals of the interior marking, as is always the case, a slower cooling.

Segregation veins and dykes (sometimes called *contemporaneous* veins) may sometimes be mistaken for intrusive sheets; they occur only in crystalline rocks (notably in granite), and may be finer or coarser in grain than the surrounding rock. They are never more than a few inches thick, and the crystals composing them interlace with those of the rock mass around, from which, in fact, they are derived. Another kind of structure sometimes mistaken for a dyke is the so-called *pseudo-dyke*. Pseudo-dykes are found on and near volcanoes; they result from the filling in of rents and cracks by ashes and scoriæ, which become consolidated either by pressure or the cementing action of percolating waters containing mineral matter in solution.

DYNAM. In estimating the effect of mechanical labour it is desirable to have some idea of a simple unit well fixed in the mind. All who have studied the subject know how much advantage there is in referring every kind of pressure to weight, and measuring it by the weight which will balance it. Thus if a weight of 100 lbs. will bend a spring into a certain position, we have no difficulty in substituting an opposite force to the weight for the recoil of the spring at the point of application. It is equally convenient to arrive at a distinct notion of a unit of useful effect in the workmanship of machines. We may consider any machine as simply applied to raising a weight, and look upon the weight raised as a dynamical synonym for any possible effect that the machine could have produced; observing that the useful effect of any application of power varies jointly as the weight raised and the height to which it is raised. Accordingly, the product of the number of pounds raised, and the number of feet to which it is raised, is a relative measure of the quantity of power. We can convert the above relative measurement into an absolute form by assuming as a unit 1 lb. raised through 1 foot; let this be called a dynam, or dynamical unit. Thus what is commonly called a horse-power is meant by our engineers to signify 550 dynams in a second; a steam-engine which can raise 1 lb. through 550 feet in every second is said to be of 1 horse-power.

This term was introduced by French writers, who called the effect of a cubic metre of water raised through one metre a *dynamie* or *dyname*. Dr. Whewell proposed to naturalize the term dynam, as applied to our most convenient units, the pound and the foot. James Watt was really the first who assumed, as a dynamic unit, the simple notion of 1 lb. raised 1 foot; but he did not venture on a name, though the now common term, the *duty* of an engine, first used by him, has reference to the number of such simple units as it is possible to obtain from the engine.

DYNAM'ETER, an instrument for measuring forces, such as the SPRING BALANCE; or for measuring power, such as the power of a telescope. The latter object is attained by the use of a microscope containing a graduated scale applied to the eye-piece, so as to observe the telescopic image measured off against the scale. A double-image optical dynameter is one which has one of its lenses cut in half, so that the contacts on opposite sides of the two circular discs representing the object glass can be observed. The half-lenses are made to slide along one another by their cut faces, the disc of the object glass of course following each half, until the opposite sides of the two images of the disc coincide. The amount of adjustment necessary to attain this is then read off on the graduated scale attached.

DYNAM'ICS (Gr. *dunamis*, force), a word of comparatively modern use, now universally adopted as signifying the science of matter in motion as distinguished from statics, which relates to matter at rest. Under so general a term our plan requires us simply to refer the reader to the several articles connected with the subject.

Dynamics may be divided into two distinct parts; the mathematical consideration of motion, without reference to any connection with its cause; and the experimental investigation of the connection between pressure and the motion produced by it, together with the mathematical exhibition of the laws under which the second is a consequence of the first. The different branches of the subject, mathematical and experimental, will be found treated of under separate heads, such as MOTION, FORCE, VIRTUAL VELOCITIES, &c.

DY'NAMITE is a mixture of nitro-glycerine and absorbent matter, such as infusorial earth, silica, mineral ash, Tripoli powder, &c. Nitro-glycerine by itself is a most dangerous compound, being liable to explode upon very trifling friction or concussion, and in consequence become the fruitful cause of disastrous accidents. To deprive it of this treacherous character, and yet at the same time to retain the intense explosive power, Mr. Nobel hit upon the plan of mixing it with *kieselghur*, a porous silicious earth, obtained in Germany, capable of absorbing three times its own weight of nitro-glycerine. It may then be made up into cartridges of any size for use, which can only be exploded by violent percussion, or by the detonation of a fulminating fuse. It is tolerably safe from being exploded by heat, a spark, friction, or concussion if not frozen. If a small quantity be ignited it burns quietly away, but if a large quantity be thus burnt there ensues a fierce heat likely to produce explosion. During storage the chief danger arises from exudation of nitro-glycerine from the earth, and the liquid so exuding is liable to explode by friction or percussion. See NITRO-GLYCERINE.

DYNE, the unit of electrical force, is that force which, acting for one second on a mass of one gramme, imparts to

it a velocity of one centimetre per second. Gramme and centimetre are terms of the metric system.

Hence the dyne gives a ready measure of quantity of electricity. The electrostatic unit of quantity for electricity is that quantity which, when placed at a distance of a centimetre from a similar and equal quantity, repels it with a force of one dyne. The electro-magnetic unit of quantity is that which is conveyed by unit strength in one second; and unit strength is ascertained when one centimetre length of circuit, bent into an arc of a circle of one centimetre radius, is placed so that the magnet pole is at the centre of this circle, and therefore always one centimetre distant from the current; and when under these conditions the centimetre of current exerts a force of one dyne upon the magnet pole at the centre. But as this unit is rather a large one, the *coulomb*, or one-tenth of the absolute unit, is generally employed as the standard.

DYNASTI'NÆ is a subfamily of the SCARABÆIDÆ, a great tribe of beetles belonging to the division LAMELLICORNIA. The Dynastinæ are chiefly tropical, and are remarkable for the horn-like processes of the head and thorax, which attain enormous development in some large tropical forms. The females are small, and are devoid of these processes. One of the most remarkable of these is the Hercules or Rhinoceros Beetle (*Dynastes hercules*), a native of the West Indies and Guiana. The thorax projects in front into a long curved horn, which extends far beyond the head and has a strong tooth-like projection on the under side, fringed with a brush of brownish-yellow hairs. The head has a long horn also, shorter by far than that on the thorax, but bending up towards it and toothed on the upper side. Mr. Wallace considers these processes to be neither weapons of offence nor ornaments, but protective against the attacks of goatsuckers, owls, and other birds. "The long pointed or forked horns, often divergent or movable with the head, would render it rather difficult for these birds to swallow such insects, and would therefore be an efficient protection, just as are the hooked spines of some of the stingless ants and excessively hard integuments of many beetles against the smaller insectivorous birds."

DYRRHACH'IUM (now *Durazzo*) was originally called *Epidamnus* by the Corcyreans who founded it. The Romans changed its name to Dyrrhachium because of its evil sound (*damnum* meaning ruin). It was the great Greek port in Roman times, situated as it was on the Greek side of the Adriatic, nearly opposite the great Italian port of Brundisium (now Brindisi). It grew rapidly in importance on this account. But its chief interest for the student of history is its connection with the most critical point in the fortunes of Cæsar. It was where Pompey commanded the republican forces in Greece, whither a considerable part of the senate had retired and were in session at Thessalonica, when Cæsar, victorious against the senatorial party in Spain, returned to Italy, and gave his attention to the East, where his opponents' strength lay. In B.C. 49 Pompey's admirals had annihilated Dolabella with the Cæsarean fleet, and Caius Antonius with the army of Illyria, and the large senatorial fleet (500 sail) lay wintering off Dyrrhachium, guarding the maritime key of Greece, supported by an army of eleven legions and 7000 cavalry under Pompey, with immense magazines and military stores amassed within the strong lines which contained the army.

In January, B.C. 48 (which, if the calendar had received the correction it was so soon to have at Cæsar's hands, would have been truly November, B.C. 48), Cæsar in his brilliant way, unequalled save by Napoleon in his earlier career, actually had the audacity to push across from Brundisium and land in Epirus (near Corcyra) with six scantily-manned legions, slipping by the great Pompeian fleet (actually in sight), and dashing towards Dyrrhachium to try a surprise. Failing in this, for Pompey was forewarned, Cæsar would have been at the mercy of a general as ready as himself; but Pompey, with four times the forces, as well as the fleet, lay on the defensive. It was now that Cæsar made his famous attempt to cross alone in a fisherman's boat, from Dyrrhachium to Brundisium, not much short of 100 miles. (The distance direct across the neck of the Adriatic from Otranto to the nearest Greek coast is but 50 miles, but at that time afforded no landing place on either side.) He was impatient to get the expected assistance of Mark Antony's legions enrolling in Italy. No fisherman would undertake the passage, and Cæsar had to devour his impatience. Fortunately Antony needed no incitement. At the earliest moment he hastened to run the blockade. At once Cæsar passed round Dyrrhachium (much as the allies passed round Sebastopol, only that he wasted no time after he got into position). Pompey had two to one on land against him, but Cæsar was ready to face these odds. He actually surrounded the Pompeian army with a chain of posts; and had he not been betrayed by deserters, might have secured an ancient Sedan against his doubly-strong opponent. But even Cæsar could not compel victory under such conditions. Pompey was informed of weak spots in the long lines of Cæsar's posts, and broke them. Now surely Cæsar, with half the troops, cut off entirely from his base, with no means of procuring supplies, was crushed? On the contrary, sternly refusing to allow his legions to recapture their standards, he marched with incredible activity into the interior of Greece, reached Thessaly in a few days, penetrated to Pharsalus in the heart of it, and there reinforced and reorganized his tired army. Pompey followed sluggishly from Epirus to the East; and on the 9th August, 48 B.C., fought the famous battle of Pharsalus, which made Cæsar master of the world. But it was at Dyrrhachium, not at Pharsalus, that the grandeur of Cæsar's character was shown, and where accordingly the interest of civilized men never ceases to centre. Once only (at Alesia, in Gaul) did Cæsar come so perilously near to utter ruin. Audacity in each case brought him into danger; still greater audacity in each case saved him. See CÆSAR.

DY'SART or **DESART,** a small ancient town of Scotland in the county of Fife, on the Frith of Forth, 9 miles N.E. of Burntisland, and 415½ from London by the Great Northern and North British railways. It consists of three narrow streets, of which the central or High Street is full of substantial old houses. It is a royal burgh (with a population in 1881 of 2645), and a contributory burgh to the Kirkcaldy district of burghs (with a population of 10,877). There are manufactures of linens and ticks, and large flax-spinning mills, and in the neighbourhood are collieries and quarries. Before the union with England it was a place of such great commercial importance as to be called "Little Holland." Coal was worked here nearly 400 years ago. The harbour is one of the best on the coast, having 18 feet of water; but the shipping consists of only a few brigs and sloops engaged principally in the exportation of coal, corn, and other agricultural produce. A little shipbuilding is carried on in the town. On the west is Dysart House, the seat of the Earl of Rosslyn, and near it are the ruins of Ravenscraig Castle. The town is mentioned in Scottish history as early as the Danish invasion of Fife in 874. In 1559 it was the headquarters of the Lords of the Congregation, and in 1607 the scene of the three meetings of the Synod of Dysart. The town was taken by Cromwell. There is a place at the harbour called the Fort, said to have been fortified by the Protector, but no remains of any work on it can now be seen. On the south or lower part of the town there are the remains of a chapel, said to have been dedicated to St. Denis. The ruins of the old church of Dysart are nearly at the same spot. One of the windows bears the date of 1570.

DYS'ENTERY (Gr., from *dys*, ill, and *enteron*, intestine), a disease in which there are difficulty and pain in passing the stools, which consist of mucus and blood, containing little or no feculent matter (what there is is commonly in the form of round and hard balls called scybalæ), and generally attended with fever. The desire to evacuate the bowels is frequent and urgent, but the effort is accompanied with severe pain, and is often altogether ineffectual, constituting the affection called tenesmus. The seat of the disease is chiefly in the large intestines; the disease itself, though manifested in many forms, consists essentially of inflammation of the mucous membrane.

The causes which predispose to dysentery appear to be long-continued exposure to a high temperature, or alternations of heat and cold; hence in hot climates this disease is most intense. In fact, it is now almost confined to warm countries, although at one time common in Great Britain. When the disease sets in, the heat, the tormina, and the tenesmus are most urgent and distressing; the thirst becomes excessive, the urine scanty or altogether suppressed, the stools slimy, streaked with blood, and attended with *prolapsus ani*, or watery and ichorous, "resembling the washings of raw beef, in which float particles or even large shreds of coagulable lymph, thrown off from the acutely inflamed surface." In these cases the prostration of strength is extreme, and is increased by most distressing and exhausting vomiting. When, as sometimes happens in this form of the disease, portions of the mucous coat of the intestine slough away, the countenance of the patient is sunk and cadaverous, and the odour of the stools, and in some degree indeed of the whole body, is putrid.

The duration of dysentery is as various as its types. It may prove fatal in a few days or hours, or last for weeks and even months, and ultimately destroy life by inflammation and gangrene of the bowels.

The remedy most to be relied upon is ipecacuanha, which has long been known as possessing special efficacy in dysentery. It is administered in large doses of from 25 up to 60 or even 90 grains of the powder. A large mustard plaster should at the same time be placed over the abdomen, and retained there about twenty minutes. The patient should maintain the recumbent posture, having the head lower than usual, and abstain from food and drink for about three hours after taking the medicine. Thirst may be quenched by sucking small pieces of ice or by a teaspoonful of cold water. After three or four hours liquid nourishment may be given, but the medicine often requires repeating after ten or twelve hours, and in smaller doses must be administered for two or three days afterwards. In malarial dysentery quinine must be given as well as ipecacuanha, being administered between the doses of the latter medicine. In chronic forms of the disease Dover's powder is sometimes of service, but the chief points to be attended to are nourishment and judicious hygienic measures, proper clothing, the use of tonics, baths, &c. A change to a cooler climate often proves of great value.

It may be observed in connection with this subject that all stools should be immediately disinfected, and in country places they should be at once removed from the house and carefully and deeply buried at a place distant from any water supply.

DYSPEP'SIA. See INDIGESTION.

DYTI'CIDÆ, a family of beetles belonging to the section PENTAMERA, and closely allied to the CARABIDÆ. The insects composing this family are almost all oval and flattened in form. They are very variable in size, some being very minute, others several inches in length. Their hind extremities are longer than the anterior, flattened like an oar, and ciliated. The antennæ are smooth. They are all aquatic insects and organized for swimming, though at the same time capable of flying through the air with facility. They live in fresh water, and swim with great rapidity, chasing other water insects, and seizing them with their anterior feet. Although capable of existing a long time under water, they are obliged to ascend at intervals to the surface to breathe. This they effect by remaining quiet, when their bodies, specifically lighter than the surrounding fluid, rise to the surface obliquely, with their head downwards, so that the extremity of the abdomen, at which the pores of the air-tubes (*tracheæ*) are situated, is exposed to the air on reaching the surface. At night they fly from one pool to another, and hence are often met with in places flooded by temporary rains. The larvæ of the Dyticidæ leave the water and bury in the earth before changing into pupæ. Thus they are at first aquatic insects, next terrestrial, and in their final stage amphibious.

The larvæ are armed with long sickle-shaped jaws, and are even more ferocious in habit and aspect than the perfect insects.

The species are very numerous and widely distributed. Of the typical genus Dyticus, the commonest British species is *Dyticus marginalis*, so named from the conspicuous yellow margin of the thorax. This species is frequently kept in fresh-water aquaria. In the genus Haliplus the hind legs, instead of being flattened and oar-shaped, are furnished with a fringe of long hairs.

E occupies the fifth place in the Hebrew alphabet, probably also in the Phœnician, as it does in the Greek (fifth and seventh if we count also Eta) and those derived from it. The vowels, when arranged according to their physical affinity, would lie in the series, *i*, *e*, *a*, *o*, *u* [see VOWELS], and accordingly *e* is frequently interchanged with *i* and *a*, and occasionally with *o* and *u*.

1. *E* is interchanged with *i*. In Latin the old datives *heri*, *mani*, *ruri*, *musai*, afterwards took the forms *here*, *mane*, *rure*, *musae*; and the words *magis*, *videris*, *tristis*, when written without an *s*, were *mage*, *videre*, *triste*. The same interchange appears in the declension of the adjective *is*, *ea*, *id*, and the conjugation of the verbs *eo* and *queo*.

2. *E* in Latin often corresponds to *oi* in French. Thus many Latin infinitives in *ēre* reappear in French with the termination *oir*, as *habere*, *debere*; *avoir*, *dèboir*. The Latin past imperfect has the suffix *eba*, which passed through the forms *eva* and *ea* to *oie* and *oi*. Thus from *habebam* were deduced *aveva*, *avea*, *avoie*, and lastly *avois* or *avais*. This final *s* does not appear in the oldest forms of the French language. Other instances of this change are *Viennensis*, *Viennois*; *mensis*, *mois*.

3. *E* Latin into *ie* French, as *mel*, *bene*, *ped*, *venit*; *miel*, *bien*, *pied*, *vient*.

4. *E* into *a*. This is well marked in the dialects of the Greek; *σοφιη*, Ionic; *σοφια*, Doric. Hence the Latins have often an *a* where the common dialect of the Greek had *e*, as *μηχανη*, *πληγη*; Lat. *machina*, *plaga*. Both forms often co-exist in Latin, as *tristitia* and *tristitie*. The *a* is often changed into *e* in Latin, if a prefix is added, particularly if two consonants follow the vowel, as *factus*, *confectus*; *pars*, *expers*; *castus*, *incestus*. See A.

5. *E* into *o*; especially in Greek, as *λεγω*, *λογος*; *νεμω*, *νομος*. The Latin language prefers the *o*, as *εμεω*, *vomo*; *πεπτω*, *coquo*; *νεος*, *novus*. This change is particularly common in words beginning with a *w*, or with what was

pronounced as a *w*, the Latin *v*. Thus *vester*, *velim*, *verto*, *veto*, were once written *voster*, *volim*, *vòrto*, *voto*. Hence likewise to the Latin *vermis*, *vellus*, *verruca*, correspond our English *worm*, *wool*, *wort;* while the German *schwert* is in English *sword;* and *vice versâ* the German *antwort* (as it were *anti-word*) is in English *answer*. Lastly, our own *worm* and *work* (Gr. ἐργον) are now pronounced as if written with an *e*. The Greek even interchanges a long *o* with a long *e*, as πατηρ, απατωρ, ευπατωρ. So in Latin *Anio*, *Anienis*.

6. *e* in Greek is changed into *u* in Latin before an *l*, as Σικελος, Siculus; ειλειν, *ululare*.

In English *E* is the most common letter; it has to be specially provided for by printers, and is the despair of cryptographers, whose system (if simple) is at once detected by translating the most numerous symbol used as *E*, and from its deducing the rest. The reason is that the symbol stands for so many sounds. Thus in the phrase, "Here and everywhere in England," we get seven *e*'s out of twenty-six letters; three of these are mute, and the remaining four have the sounds of *ee*, *ê*, *a*, and *i* respectively. *Angland* (land of the Angles) came to be called *England* by the times of the English Chronicle, and is now pronounced *Ingland*. The French nation still adapt the spelling to the oldest pronunciation *Angleterre* (which pronunciation they preserve), while the Germans keep to our middle pronunciation and the corresponding spelling *England*, and the Italians spell phonetically *Inghilterra* according to our present altered speech. We alone speak in one way and spell in the way of a speech seven or eight centuries gone by.

E in combination presents some curious anomalies in English. Space only permits us to notice *ea*, *ei*, *ie*. In Chaucer's time *e* was almost the French *e*, his word *grete* is our *great* exactly; his *plese* is the country folks "plaise," our *please*. But as the simple *e* grew more and more to have the *ee* sound—an extraordinary perversion peculiar to English alone—men later on thought to check it by spelling those words which still retained the Chaucerian pronunciation with *ea*, the new-fashioned *a* (the *a* of *hatĕ*) taking the sound, the *e* being ignored; so *beste* (Chaucer) became *beast*, *i.e.* as the Irishman still calls it "baste." When tea was introduced, the sound which the French try to imitate by *thé* and the Germans by *thee* was unanimously expressed by *tea*. Thus Pope, in the well-known lines ("Rape of the Lock," canto iii.):—

> "Here thou, great Anna, whom three realms obey,
> Dost sometimes counsel take and sometimes tea" (tay).

The Irishman with his "aisy, then," his "over the say," &c., retains the speech common when his country was subdued in the seventeenth century. But though we have still *great*, *break*, and a very few others among us, the wave in favour of *ee*, checked for centuries by using *ea* for the simple *e*, has now swept over us; we say *tee*, *speek*, and even many persons now say *breek* (break). This double-letter *ea* must not be confused with the Old English diphthong EA, as in *Eadward*, &c. (The latter would be roughly imitated by *Yadvard*.) *Ei* represents another *ee* sound (*receeve*, *perceeve*) which was truly an *a* sound up till nearly our own century, our forefathers *recayving* and *percayving* like the Irishmen of to-day. *Ie* on the other hand is an *ee* sound in its origin. Tom Moore sings, "Believe (beleeve) me if all those endearing young charms," not belayve me.

E, in music, is the fifth letter of the "musical alphabet," being the fifth note of the scale in the Greek Hypodorian mode (the scale given by the white notes on the pianoforte, starting from A), which was the normal scale when letters were introduced as names of notes. In the ecclesiastical modes of the early church [see MODES, ECCLESIASTICAL], and in the GREEK MUSICAL SYSTEM, E was the keynote of the Phrygian mode, but the scales of the two systems differ materially. Our own normal scale is that of C major, which is playable on the white notes of the pianoforte, starting from C; and in this scale E is the third note. Accordingly, in the nomenclature of France and Italy (*do*, *re*, *mi*, &c.) E is called Mi. In our own use of these syllables in the sol-fa system Mi simply means the third of any key, and care must be taken not to confuse English and continental usage in this respect. E major and E minor in English are Mi majeur and Mi mineur in French; E sharp and E flat are Mi dièse and Mi bémol (Ital. Mi diesis and Mi bemolle). In German the key of E major is E dur, E minor is E moll, E sharp is not specially named, E flat is Es, and E flat minor is Es moll.

The key of E major has four sharps (those of F, C, G, D), and that of E♭ major has three flats (B, E, A); E minor is the relative minor to G major, and the relative minor to E♭ major is C minor. E is the first (highest) string of the violin, and is not possessed by any other of the stringed instruments as the note of an open string except the four-stringed contrabasso, where it is the fourth (lowest) string.

EAD'MER, the friend and historian of Archbishop Anselm, lived in the twelfth century. He received a learned education, was a monk of Canterbury, and became the bosom friend and inseparable companion of two archbishops of that see, St. Anselm and his successor Ralph. In 1120, by the desire of Alexander I. of Scotland, he was elected bishop of St. Andrews; but as Alexander refused to allow him to be consecrated by the Archbishop of Canterbury, for which Eadmer contended, he abandoned his bishopric, returned to England, and died, it is said, in 1124. Eadmer is now best known for his history of the affairs of England in his own time, from 1066 to 1122, especially full and patriotic in recounting the struggle of Anselm with Rufus. The best edition is that by Selden, entitled "Eadmeri Monachi Cantuariensis Historiæ Novorum, sive sui Sæculi, Libri Sex" (folio, London, 1623).

EAD'RED, EADRIC, EADWIG, EADWINE. See under the modern spelling EDRED, EDRIC, EDWY, EDWIN. *Ea* is a diphthong in Old English (Anglo-Saxon), each vowel being slightly sounded. A very rough approximation would be given to the original sound by saying Yadred, Yadric, &c.

EAGLE, the Roman standard. The eagle is often seen on ancient coins and medals, as on those of the Ptolemies of Egypt and the Seleucidæ of Syria. As an ensign or standard borne upon a spear it was used by the Persians in the time of the younger Cyrus (Xenoph. "Anab." i. 10).

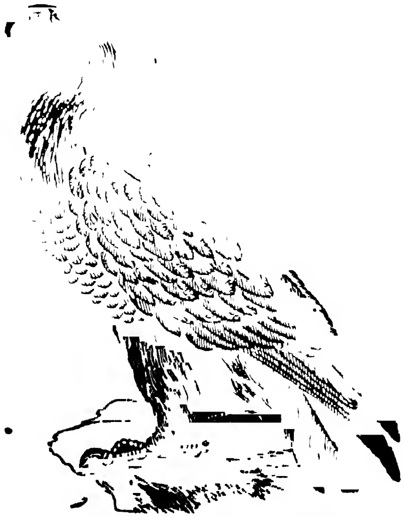
The Romans at first used four different animals for standards—the wolf, the minotaur, the horse, and the boar, as standards of the three divisions of the infantry and of the cavalry respectively; but in the second consulship of Marius they adopted the eagle as the sole ensign for their legions.

The eagle used by the Romans as a standard was of gold or silver. It was borne on the summit of a spear, and was of the size of a pigeon with its wings extended. The name of the legion was usually engraved upon it. Tacitus ("Annals," i. 60) relates the finding of the eagle of the nineteenth legion of Germanicus, which had been lost in the massacre of Varus.

The regal successors of the Romans preserved the same emblems. The sovereigns of the Eastern Empire assumed a golden eagle, while those of the Western Empire adopted the black one. When Charlemagne became master of Rome and the whole German Empire, he added, A.D. 802, a second eagle, in order to denote the union of the empires of Rome and Germany in his own person. Thus we find that the eagle, being the emblem of strength and courage, has been universally preferred as an ensign of sovereignty; and almost every state which has been entitled to the designation of empire, from the period of the Romans, has

adopted the eagle for its national banner, as Austria, Poland, Russia, Prussia, and France. When the two-headed eagle has been assumed, it is indicative of double empire, as in the case of Charlemagne and the emperors of Germany. This emblem was continued by the emperors of Austria, who still looked upon themselves, even after Bonaparte had deprived them of their imperial title, as emperors of Germany. Greatly to the regret of Franklin the peace-lover, the royal bird of prey was also adopted by the United States as their emblem; and with the emblem has remained somewhat of the spirit it enshrines, so that the "spread-eagleism" of the vulgar American much resembles the "chauvinism" of France or the "jingo fever" of England.

EAGLE is a name applied to many of the larger and more powerful birds of prey belonging to the family FALCONIDÆ, though considerable difference of opinion exists as to the exact limits of the name. The eagle was long regarded as the king of birds, the emblem of magnanimity and of courage. But in these days of destructive criticism the fate of his brother monarch, the lion, has overtaken him, and he has been discrowned and stripped of his moral and physical supremacy. Nevertheless some consideration is still due to the bird that bore the thunderbolts of Jupiter, became on the standards of Rome the symbol of conquest and civilization, and in later times was adopted as an



Golden Eagle (*Aquila chrysaëtus*).

emblem of empire by France, Germany, Russia, Austria, and the United States of America.

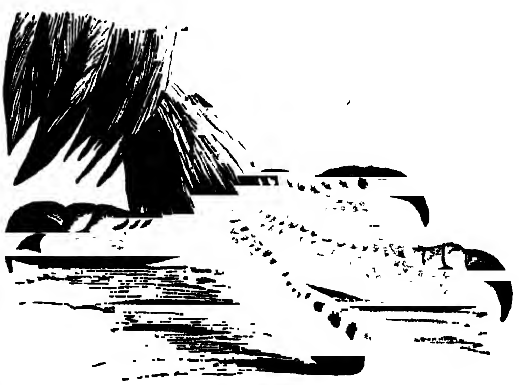
To treat fully all the birds to which this name has been applied is impossible here. The Golden Eagle (*Aquila chrysaëtus*) may be selected as typical both in structure and habits of many of these birds. This magnificent bird is found not only in Britain and in all the mountainous parts of the continent of Europe, but also in Asia as far to the east as Northern India, in the north of Africa, and in North America. Formerly this eagle was common in our island, and bred in the peak of Derbyshire, in Cumberland, Westmorland, and other rocky and mountain districts; at present, however, it is almost exclusively confined to the mountain ranges of Scotland and its western and northern islands, and only survives here through the protection of some of the landowners. Its usual length is about 3 feet, and the wings spread 7 or 8 feet when extended. The general colour of the plumage is dark brown, with the belly and thighs bay, and the quill feathers of the wings blackish. The tail feathers are varied with two shades of brown; the beak is of a bluish horn colour, the cere and toes are yellow, and the claws black. The tarsi are clothed with feathers down to the root of the toes.

In its structure the golden eagle exhibits the characteristics of its tribe in the highest perfection. Its beak is rather short, but exceedingly powerful, and the upper mandible terminates in a strongly-hooked and acute point; but the sharp teeth which in the falcons are found on the

Head of the Golden Eagle.

margins of the mandible are here represented only by a slight festoon. The feet are enormously strong, and the toes armed with claws of great length and acuteness, curved in such a manner that the grasp of the foot must immediately bury them in the body of the prey. The eye is protected from the intensity of the sun's light by a large bony ridge.

The flight of this bird, as might be expected from its great length of wing, is most majestic and powerful. Its great strength enables it to prey upon creatures whose size would prevent them from being attacked, or at all events being carried off, by any of the smaller Falconidæ,



Foot of the Golden Eagle.

and although it does not contemn such small game as partridges and grouse, it destroys lambs, even when several weeks old, and young fawns, which its great muscular power enables it even to carry off in its talons to its nest among the rocks. Hares and rabbits also constitute a considerable portion of its food. It does not, however, confine itself to preying on living animals, as its admirers would have us believe, but feeds to a large extent on carrion. Nor is its courage equal to its size and strength,

for the peregrine and many other falcons will attack and drive away the robber with scarcely a show of resistance on his part. The nest, or eyrie, composed of sticks, heath, &c., is generally placed on the ledge of some inaccessible precipice, sometimes on the branches of a tree springing from the face of a tall cliff, on the wildest part of the mountains. The eggs are two in number, of a grayish-white clouded with spots of reddish-brown. The young are plentifully supplied with food.

The Spotted Eagle (*Aquila nævia*) is another European species, of which specimens have been killed in Cornwall. It is an inhabitant of the mountainous districts of Central Europe, but extends its range southward into Egypt; it also occurs in Asia as far as Nepal and Calcutta. It is considerably smaller than the golden eagle, being about the size of a large cock. It feeds on small quadrupeds and birds, and builds its nest on high trees, laying two eggs slightly blotched with red.

The Imperial Eagle (*Aquila imperialis*), which is also common to Europe and Asia, and yields only to the golden

Imperial Eagle (*Aquila imperialis*).

eagle in size, abounds particularly in Turkey, Egypt, and the north of Africa. It inhabits the hilly districts, and when in search of prey flies slowly along at no great elevation, hunting over the bushy valleys and ravines.

A peculiar eagle (*Aquila audax*) inhabits Australia. It has a long wedge-shaped tail.

The eagles of the genera Spizætus, Circætus, Spilornis, and Helotarsus scarcely need detailed notice. The genus Haliætus will be noticed under SEA EAGLE. The so-called bearded eagle, or LÄMMERGEIER, is rather a vulture than an eagle.

EAGLE OWL (Bubo) is a genus of OWLS (Strigidæ) characterized by a small *concha* or earflap, and by the facial disc being somewhat incomplete. Two tufts or feathered horns of considerable size adorn the head, and the legs are feathered down to the toes.

The Great Eagle Owl (*Bubo maximus*), the largest of the nocturnal birds of prey, is common in Russia, Hungary, Germany, Switzerland, and the northern portions of Europe generally, but it is rare in France and England; indeed, it can only be regarded as a chance visitor, driven in by storms from the north. It is also found in Asia. Young fawns, partridges, grouse, hares, and rabbits form the prey

Great Eagle Owl (*Bubo maximus*).

of this magnificent bird, which equals some of the eagles in size. When full-grown this bird measures from 24 to 28 inches in length, the females being the largest. The colour of the plumage on the head, neck, and back is reddish-brown, streaked and mottled with dark brown; the quill feathers of the tail and wings are barred transversely with dark brown; the feathers of the facial discs are light brown, speckled with black, and below the face are some white feathers, forming a more or less distinct irregular white band; the lower surface is pale brown, spotted and barred with dark brown. The head is ornamented with two large tufts of feathers which stand up above the eyes like horns, and the feet are feathered down to the extremities of the toes. It breeds in the hollows of rocks, in old ruinous castles and similar places, or on lofty trees; the female lays two or three eggs, larger than those of a hen, round at each end, and of a bluish-white colour. The eagle owl seems a regular Ishmaelite among diurnal birds, being mobbed and attacked by crows, falcons, and other birds whenever it appears by day.

The Virginian Eagle Owl (*Bubo virginianus*), or great horned owl, is somewhat smaller than the great eagle owl. It is widely dispersed throughout North America. Its favourite residence is among the gigantic trees of the swamps. Its food consists of rabbits, squirrels, rats, mice, partridges, and other small birds and quadrupeds; and it occasionally steals chickens from their roosting places in the farmyard. The nest, which is of considerable size, and composed of a great mass of sticks, lined with a few dry leaves and feathers, is built on the forked branch of a tall tree, and in it the female deposits four eggs, which are nearly round and of a pure white colour. Its nocturnal cries seem to be even more weird, or rather diabolical, than those of the European species. The American Indians entertain a strong superstitious feeling with regard to owls; and this horned owl, which appears to possess the properties necessary for inspiring superstitious dread in a pre-eminent degree, is made use of by the priests of some tribes of Indians as a fitting symbol of the supposed mysteries of their office. There are two Indian species of this genus, *Bubo bengalensis* and *Bubo orientalis*; they are, however, not so strictly nocturnal in their habits as the American species.

EAGLE-WOOD, one of those substances of which the name, from similarity of sound in a foreign language, has been converted into another having no reference to its original signification. It is a highly fragrant wood, much esteemed by Asiatics for burning as incense, and known in Europe by its present designation ever since the Portuguese visited and imported the substance direct from the Malayan Islands and the kingdom of Siam, where it has always been abundant and long established as an article of commerce. The Malayan name is *agila*, whence the wood was called *pao-d'agila* by the Portuguese, and has since been converted into *pao-d'aguila*, *pao-d'aquila*, *bois-d'aigle*, and *eagle-wood*.

The wood in its normal state is very light, soft, white, with a slight tinge of yellow, and not unlike the softest porous deal, every part without either taste or smell. The fragrant character of the commercial eagle-wood is due to the secretion of a resinous matter in a small percentage of the trees, and that only in portions of the trunk and branches. Numbers of trees are thus destroyed in the search for the dark veins of odoriferous wood. Eagle-wood has been used as an incense from very early periods in India and China. In China it is used in a very economical manner. The wood, being reduced to a fine powder and mixed with a gummy substance, is laid over a small slip of wood, about the size of a bulrush, so as to form a pretty thick coating. This is lighted, and gives out a feeble but grateful perfume. French authors inform us that the eagle-wood was burned as a perfume by Napoleon in the imperial palace. The tree which supplies eagle-wood is *Aquilaria agallocha.* Loureiro described the fruit of a tree which was a source of a fragrant wood like eagle-wood, as consisting of one-seeded pods. This was formed into a new genus Aloexylon, and was placed among the Leguminosæ; but botanists have not since met with the plant, and as his description of the flowers appears to apply to Aquilaria, it is supposed that the natives passed off upon him the fruit of a totally different tree. See AQUILARIA.

EAL'DORMAN (an Old English word pronounced somewhat like *yaldorman*), the "elder" or chief of the ancient Teutonic tribes, yielding his sway to the dictator (*heretog*) in time of war. As with the *maires du palais* in mediæval France, or the tycoons in Japan in our own time, so here the heretogs became permanent kings and the ealdormen their subordinates. In England the subkingdoms were ruled by ealdormen, and when the subkingdoms, like the tribal divisions of the larger kingdoms, took the name of *shire* (Old English *scir*, a part) it was an ealdorman who governed each shire. This officer was appointed by the king and his witan, and was an executive national officer of large powers—not necessarily noble nevertheless. The office often passed from father to son, but was in nowise hereditary. The ealdorman sometimes ruled two or more counties. He led the army, he presided at the shire-mote, and received the third of the court-fees; and with him sat the sheriff and the bishop. The sheriff was the representative of the king, to announce the new laws, to guard the king's rights, collect his dues, &c. Gradually the sheriff became the chief officer, and after the Conquest the ealdorman ceased to attend. Long before this, in Ethelred's time, the Danish title of earl (*jarl*) had superseded the English one of ealdorman; and at the Conquest the earldoms sank from administrative posts into honorary dignities.

EAL'DRED, English Archbishop of York, who crowned not only Harold but also William the Conqueror, since Stigand's consecration to the see of Canterbury was doubtful (or was it that Stigand refused the ignominy of crowning the foreigner?), was abbot of Tavistock when we first hear of him. In 1046 he became bishop of Worcester, and at once came to the front of affairs. It was he who was the peacemaker between the turbulent Swegen, eldest son of Godwin, and the incensed and outraged king, Edward the Confessor. Probably Swegen's violation of the abbess of Leominster had done him more harm with the king than his other crimes involving many lives. Again it was Ealdred, always on the side of national union, whether by conciliation within or resistance without, who assembled troops in Gloucester and Herefordshire in 1049, and partly repelled a dangerous Danish invasion. In the end Ealdred was beaten at his new profession; but the Danes, though victorious, sailed away, having had quite enough of such conquests. And when Edward turned the kingdom into a preserve for French favourites, and Godwin and his sons were driven out (safe-conducts even being refused to them to permit them to defend themselves from crimes imputed to them), it was Ealdred who had to pursue them in their flight, and who took care not to catch them.

As the king was childless, Edward the Atheling (prince-royal), son of Edmund Ironside, as chief of the royal family after the king, was sent for from Hungary, whither he had fled during the Danish rule over England. Ealdred again it was who conducted this negotiation successfully in 1054. The Atheling arrived in consequence in England (1057), and died at once on landing. His son Edgar then became Atheling in his stead, and as such the most likely person to be chosen king by the witan. In 1058 we find Ealdred consecrating Gloucester minster, and then starting on a pilgrimage to Jerusalem. On his return in 1060 he succeeded Cynesige as archbishop of York; but on going to Rome for the embroidered scarf called the *pallium*, which was always conferred upon archbishops by the pope himself, Pope Nicholas not only refused Ealdred the pallium, but deprived him of his see of Worcester for the ecclesiastical offence of holding two sees at once. Eventually, however, Ealdred got his archbishopric on condition of giving up the bishopric to him who afterwards became St. Wulfstan.

Edgar the Atheling was so young when Edward the Confessor died in 1066 that in the troubled circumstances of the time it was felt necessary to depart from long usage, and choose the best and wisest man to be king, even were he not of royal blood. It was upon Earl Harold, son of Godwin, that the choice fell, the earl and his family having been recalled long before, almost by necessity. Stigand, archbishop of Canterbury, was long without the pallium, for his Norman predecessor had been deposed without consent of the pope, and when he got it, it was from the hands of a pope (Benedict) whose own election was in dispute. To avoid error, therefore, it was Ealdred who crowned King Harold in the Epiphany of 1066. And it was again the patriotic Ealdred who, after Senlac (Hastings), convoked what witan he could at London, where they determined to resist the Norman, and chose Edgar the Atheling to be king. But the great midland and northern earls, Edwin and Morkere, proved traitorous, and the country, bare of defence, yielded very readily to William's advance. Ealdred and the young King Edgar saw at last that resistance was hopeless, and met William at Berkhampstead to submit themselves. Probably for the same reason as Harold had, William ordered Ealdred, not Stigand, to conduct his election and coronation in Westminster Abbey. The question was first put to the Normans, in French, and then by Ealdred it was asked in English, "Will ye that William, duke of the Normans, be crowned king of the English?" Then the people cried "Yea! yea!" so loudly that the Norman guard outside feared treason, and set fire to houses round the abbey. The English, as they expected, rushed from the minster to save their property, and few but the clergy saw Ealdred put the crown on the head of the Conqueror that Christmas day, 1066. In fact, Ealdred had a trying part to play, and

played it for his country the best he could. William the Conqueror, a noble enemy, if a fierce one, esteemed him none the less for his coronation of Harold a few months before himself, and for the election of Edgar only a few weeks before his own. Ealdred held his see till his death in 1070, when the Norman, Thomas of Bayeux, succeeded him; so that at Ealdred's death St. Wulfstan, whom he had himself consecrated first Abbot of Gloucester, and then Bishop of Worcester, remained the only English prelate in the kingdom. As Harold was the last of the old English kings, so also was Ealdred the last of the old English archbishops.

EAR. The only essential part of the organ of hearing is a nerve, not materially different from those of common sensation, lodged at a sufficient depth to be secured from external injury, and sufficiently sensitive to be affected by the delicate impulses of atmospheric undulations. This is called the acoustic or auditory nerve.

Among the invertebrate animals, the Cœlenterata and Echinodermata (star-fish, sponges, &c.), which constitute the lowest division of the animal kingdom except the Protozoa and the Infusoria, appear to be universally unprovided with an organ of hearing, and are therefore probably altogether devoid of the sense. Many of them have no traceable nervous system. It is now, however, generally the custom to assume provisionally that vesicles filled with fluid, on the walls of which a nerve ends, containing concretions of the nature of "ear sand" and ciliated nerve-cells or "auditory hairs," are probably auditory organs. In many species of Vermes (worms) such organs are found near the cerebral ganglia.

The Arthropoda, more especially the Crustacea (lobsters, &c.) and Insecta (spiders, &c.), seem to have organs of hearing. The parts of the ear which are found in these animals are a cavity which is called the vestibule, a soft membranous bag of fluid called the vestibular sac, and a round external opening, called, from its shape in man and most other animals, the *fenestra ovalis* (the oval window or opening). There are fluids within and without the sac. Such are the air-breathing insects of the orders Hymenoptera (bees), Orthoptera (grasshoppers), and Coleoptera (beetles), the Arachnida (spiders), and the Crustacea, such as the lobster and crab.

The Mollusca, though placed higher in the scale of animals, do not afford such clear examples of a distinct organ of hearing as the Arthropoda. Such as have been discovered all belong to the order of the Cephalopods with two branchiæ or gills, which approach more nearly to the true fishes in their structure than the other molluscs.

The vertebrated classes of the animal kingdom, comprising the true fish, amphibians, reptiles, birds, and the mammalia, are all provided with acoustic organs, which are very various in their degrees of complexity, but much exceed in that respect the comparatively simple organs of the inferior divisions.

In the cartilaginous Fishes, such as the ray and the shark, the vestibule is deeply imbedded in the elastic walls of the back part of the cranium, near its junction with the spine. The fenestra ovalis, closed by a tense transparent membrane, faces upwards, backwards, and towards the middle line, and may be considered as a rudiment of the tympanum or middle ear of the higher vertebrata, with its Eustachian tube. The inner surface of the membrane is turned towards three *sacculi*, one of which is much larger than the rest, arranged at the opposite side of the cavity of the vestibule, and containing each an otolith (ear-stone), often very large, as in the familiar example of the cod. Besides the fenestra ovalis other perforations lead out of the vestibule into three arched cylindrical canals of considerable diameter and dimensions, the diverging curves of which take a wide circuit within the cranial cartilage, and terminate at both ends in this central cavity. Within the canals in which the vestibular perilymph freely circulates, there are three similarly curved but more slender membranous elastic tubes; they are nowhere in contact with the sides of the canals, but are suspended in the midst of them by means of cellular network. They all swell out at one end like a flask (*ampulla*) as they enter the vestibule, after which the anterior and horizontal tubes separately enter a common pouch or sinus. Into this their other ends likewise open by a conduit common to both. The acoustic nerve is distributed in two principal branches only to the sacs and the ampullæ—chiefly to the latter, to which it gives a white colour.

In Serpents there is but one sacculus containing chalky matter, and all the semicircular tubes communicate with a central membranous sinus, which the anterior and posterior tubes enter by a common trunk. The fenestra ovalis is closed, not as in fishes by a membrane, but by the expanded trumpet-shaped extremity of a slender bone (*ossiculum* or *columella*), attached at the other extremity by a ligament to the outer end of the intermaxillary bone.

Nearly the same arrangement of the internal ear prevails in the four-footed Reptiles (turtle, crocodile, frog, lizard); but a new and important step is here made towards the ultimate perfection of the organ by a development of an air-cavity, called the tympanum, or ear-drum, between the vestibule and the surface of the head.

In Birds, besides a greater nicety and tenuity in the conformation of the parts hitherto described, the ear is furnished with two additional provisions. The first is a short *meatus auditorius externus*, or outer passage, which removes the delicate membrane of the tympanum to some depth from the surface of the head, and thus places it more securely, and at the same time to greater advantage for observing the direction of sound. The other additional provision in birds is an appendage to the mechanism of the internal ear. This is a small conical cavity in the bone, somewhat curved, with a ridge winding round the interior, and a cartilaginous structure so corresponding in form with the ridge as to divide the cavity into two partitions. These communicate with another at the apex, and with the vestibule and tympanum respectively at their other ends. The cavity is termed the cochlea, from its resemblance (in mammals) to a spiral shell.

In the Mammalia the ear reaches its complete development. It is nearly the same in all of them, including man, the difference being only in the comparative size and shape of the component parts of the organ, and not in their essential structure, number, or arrangement.

The Human Ear.—The parts may be described under a threefold division of the internal, middle, and external ear, and the whole organ is fully illustrated in our Plate. It should be added that the chambers of the inner ear (bony labyrinth) are merely cavities in the petrous portion of the temporal bone; these cavities are filled with fluid (perilymph), and floating in the fluid is the organ of hearing (membranous labyrinth), of very small dimensions in comparison with the cavities containing it. The membranous labyrinth is divided, as will be seen, into three parts—the utricle and saccule, the three semicircular canals (not much thicker than a hair), and the scala media of the cochlea; and all these divisions contain the fluid called endolymph.

1. The internal ear, or labyrinth, is deeply placed in the interior of the head, within the petrous (rocky) portion of the temporal bone. Near the inner point of the temporal bone, which nearly meets its fellow of the other side of the skull (the two forming a broad V-shaped outline, of which the apex lies towards the nose), and upon its posterior declivity, there is a large trumpet-like hole (*meatus auditorius internus*) into which the seventh cerebral nerve enters from the *medulla oblongata.* After penetrating about half an inch it splits into several sets of filaments, and finds its way through small sieve-like openings at the

bottom of the lower fovea into the internal ear, and is here distributed in three separate portions to the cochlea, the ampullæ of the semicircular tubes, and the utricle and saccule of the vestibule. The cochlea is more complicated than in birds; it consists of a spiral canal in the bone, gradually diminishing as it ascends to a point, wound two and a half times round a central hollow pillar of bone called the *modiolus*. The cochlea lies nearer the nose than the semicircular canals, and in such a position that the modiolus is roughly horizontal, the top of the cochlea pointing towards the external ear. It is easy, therefore, to distinguish between a right and a left cochlea. From the modiolus a thin and spongy lamella of bone projects horizontally rather more than half across the canal, ascending in a similar spiral. From the edge of this lamella (called the *lamina spiralis*) a membrane passes to the outer surface of the canal, where it is attached, thus completing the separation of the canal into two *scalæ*, or winding partitions, which unite at the summit, the lower and narrower connected with the vestibule, the superior and larger with the tympanum; each scala being closed below by a membrane, and taking two turns and a half round the modiolus in ascending from the base of the cochlea to the cupola, or inverted cup-shaped cavity at the summit, placed over the funnel (*infundibulum*) into which the top of the modiolus expands. The modiolus is hollow to some distance from the base. Up this tubular cavity rises the large cochlear branch of the acoustic nerve, giving off lateral filaments through minute openings arranged spirally, which pass through the light spongy bone, and emerge from different points into the scala media between the two main scalæ, presently to be described; the rest of the cochlear nerve passes through capillary perforations in the cul-de-sac of the tubular cavity, and ascending in the substance of the central pillar of the modiolus, is distributed through the bone in a similar way to the upper turns of the cochlea and the infundibulum. The two other branches of the acoustic nerve are distributed to the two parts (utricle and saccule) of the vestibular sac, which lie in a round depression or pit in the barrel-shaped cavity of the vestibule, and to the ampullæ of the semicircular canals. The principal opening from the vestibule is the fenestra ovalis, situated on the outer side towards the tympanum, which is closed by a membrane; at the lower and front part there is another opening into the scala vestibuli of the cochlea. There are five openings at its posterior and outer side, which lead into the semicircular canals, of which the superior and posterior enter the vestibule by a common foramen. The saccule and utricle each contain a cretaceous deposit, which, in some of the lower mammalia, has the consistence of soft chalk. The cochlea and semicircular canals, from their complexity, are termed the labyrinth.

The uses of the various parts of the inner ear have received very various explanations at times. The following is the present theory, and is supported by so many experiments and observations as to gain universal support. The fine auditory hairs found in the saccule and utricle (vestibular portion of the organ) and in the ampullæ (flask-like ends of the semicircular canals) are believed to intensify the vibrations of the endolymph contained within the organ, and by their tremor to stimulate the nerve cells spread over the floor of these membranous cavities. A dull sensation of sound is held to be thus given without any precision. The small otoliths (ear-stones) serve as dampers, to prevent over-excitement of the auditory hairs. But it is thought that the main function of the semicircular canals themselves is not to awaken the sense of hearing, but that of motion, and especially of rotation. The pressure of the endolymph on the sides of the tubes by centrifugal force would indicate this very clearly. Besides, it is a matter of fact that inflammation of the semicircular canals (Menier's disease) induces a constant sense of whirling round; whereas it is disease of the cochlea that creates an incessant droning or musical noise. Experiments on animals also lead irresistibly to the same conclusion.

It is the cochlea which is the organ of music, if not of sound. It has been already described in general; divided into two scalæ, as if one were to take a piece of india-rubber tube, thrust a partition into it till it looked like a Greek Θ, and then wind it round a core or modiolus two and a half times. But if one were to split the division in its thickness half across, and spread asunder the split halves till the division looked like a ≺ laid upon its side, it is evident that a third scala, of triangular section, would exist between the other two. This then is the construction of the cochlea; and while the scala vestibuli and scala tympani contain perilymph like all the rest of the bony labyrinth, the scala media, which is very much smaller than they (as are all the parts of the membranous labyrinth than those of the bony labyrinth in which they lie), contains endolymph. Continuing our rough illustration, the tail of the Y is the bony lamina spiralis, and the arms are the upper, the membrane of Reissner, simply a membranous partition between the scala media and the scala vestibuli; the lower, the basal or basilar membrane, at once cutting off the scala tympani and supporting the organ of Corti on its floor. This organ of Corti, so well defended, is the special organ of musical sound. Its principal parts are a series of arches, each formed by two cartilaginous rods standing on the basilar membrane like an inverted letter Λ, and so supporting four ranks of cells on each side. The nerve filaments entering from the modiolus through the substance of the lamina spiralis, pass through a *ganglionic plexus* contained therein, like the plexus in the retina of the eye, and the filaments issuing from the plexus pass some of them into the four rows of slanting nerve-cells leaning against the nearer rod of Corti, and the rest passing along under the basilar membrane beyond the arches of Corti, pierce upwards through it, and thus terminate in the corresponding four rows of cells leaning against the outer rod of Corti. These outer nerve-cells are ciliated (end in hairs).

There are 3000 of these arches, forming a little slanting tunnel, as it were, resting midway in the basilar membrane, and following the curve which the whole cochlea makes (for economy of space) round the modiolus. The base of the arches becomes greatly wider as we proceed towards the apex of the cochlea, and as the rods remain the same size (or to be exact, increase only slightly in size), the roof of the little tunnel becomes lower, so to speak. The whole organ seen from above is held to present a resemblance to the keys of a pianoforte. Professor Helmholtz arrived at the conclusion that each arch of Corti is tuned to a particular note of music, the narrow lower arches being affected by treble sounds, the wide upper arches being affected by bass sounds. The reasoning by which he arrived at this is too much in detail for these columns, but it at once commanded respect, and is now everywhere received as the true explanation of the organ. (Ellis's "Helmholtz on Sensations of Tone," London, 1875.)

2. The middle ear comprises the cavity of the tympanum with its contents; the cells in the bony prominence

Bones of the Ear, of their natural size. *m*, malleus; *i*, incus; *s*, stapes; *o*, orbiculare.

behind the ear, called the mastoid process, with which the tympanum communicates; and the Eustachian tube, or passage leading from the tympanum into the upper and back part of the throat, where it opens in the form of an expanded slit on each side behind the posterior nares.

The tympanum is an irregular cavity scooped in the petrous portion of the temporal bone, between the vestibule

and the external meatus. The principal entrances to it are the fenestra ovalis* and the round or somewhat oval opening at the bottom of the external passage upon which the membrana tympani is stretched. Between these there is extended a chain of three small bones, obliquely articulated to each other with perfect joints, as shown in Plate.

These bones are called respectively the *stapes* (stirrup), the *incus* (anvil), and *malleus* (hammer), from some similarity in form to those implements. The base of the stapes is applied to the fenestra ovalis, exactly fitting it, and is attached firmly to its membrane. The extremity of the longer leg of the incus is articulated to the head of the stapes, and there is a minute bone between them of the size of a small shot, which is generally considered to be only a process of the incus. It is, however, called from its spherical shape the *os orbiculare*, and is sometimes reckoned as a fourth bone. The shorter leg of the incus rests against the bony parietes of the tympanum at the back part, near the mastoid cells. Upon the hollowed cavity in the head of the incus the lateral depression of the head of the malleus is articulated and moves easily; the long handle of the latter is attached by its extremity to the middle of the membrana tympani, as well as by a portion of the side of the handle, which lies close to and parallel with the membrane. The long slender process of the malleus lies in a slit passing to the articulation of the jaw called the glenoid fissure.

The use of these bones is undoubtedly to transmit the vibrations of the membrana tympani to the membrane of the fenestra ovalis, and thence to the internal ear, and thus to permit the membrana tympani to be drawn into a conical shape, so as to tighten it and adapt it either to resist the impulse of too loud a sound or favour a more acute or gentle one. This is done by a series of small muscles which are not under the dominion of the will, being supplied with nerves in a way peculiarly interesting to a physiologist, and acting automatically in correspondence with the impressions on the auditory nerve.

The fenestra ovalis is situated nearly opposite the membrana tympani, on the upper edge of a prominence called the *promontory*, and beneath it is the fenestra rotunda, closed by a membrane, and leading into the scala tympani of the cochlea. Besides these openings from the tympanum, there are others which lead into the mastoid cells behind it. These are also filled with air, and are supposed to contribute to the distinctness of the tympanic vibrations. There is also an opening from the tympanum forwards into the Eustachian tube.

Deafness arising from closure of the Eustachian tube has been sometimes cured by dilating that canal by instruments passed for that purpose into its outer expanded extremity through the nostrils or from the back of the throat, or by injecting fluids into it by means of a syringe with a small curved pipe. The use of the Eustachian tube is to admit air, and so prevent tension on the tympanic membrane from difference of the pressure of the air within and of that without, and also to serve as a channel for carrying off mucus, &c.

3. The external ear consists of the *meatus auditorius externus* and *concha*. The former, commencing from the membrana tympani, is an osseous canal in the first part of its course in the adult, and then becomes nothing more than a tubular continuation of the expanded cartilage of the concha or outer appendage of the ear. It is lined throughout with a delicate skin, covered by thin cuticle, which also covers the outer surface of the membrane. Beneath the skin, and opening through it on the surface, are numerous glandular follicles which secrete the ear-wax or *cerumen*. The wax, which is very bitter, serves to prevent the entrance of insects and to keep the skin soft. When secreted too abundantly it is often a cause of deafness, and should be removed as a foreign body by means of a syringe and a solution of soap and warm water The commonest kind of earache is that caused by the inflammation of this passage, and is generally followed by a copious and fetid secretion poured out by the ceruminous follicles. If this last long deafness is sometimes the result from thickening of the membrane, and has been removed, as well as that arising from closure of the Eustachian tube, by puncturing the membrane.

The *concha*, or *pinna*, or *auricle* (for by all these names the outer appendage of the ear is known), consists of several pieces of elastic cartilage expanded in a form more or less resembling an ear-trumpet in different animals. In man it serves the purpose of collecting the sonorous vibrations and directing them into the meatus externus much less perfectly than in many other animals, which are also provided with muscles for directing it to the source of sound, muscles which in man are but rudimentary. We here annex a detailed explanation of the figures shown in the Plate EAR.

Fig. 1. Pinna or external ear: *a a'*, helix; *a'*, the notch of the helix, marking what was once the point of the ear; *e k*, fossa of the helix; *d f*, antihelix; *l*, fossa of the antihelix; *m*, concha; *g*, tragus; *h*, antitragus. The lobe is not fully drawn.

Fig. 2. Small muscles of the pinna: *d e f g*, muscles tending to draw the cartilages closer, and make the cavity deeper—neutralized by one muscle (fig. 3, *d*) at the back, which tends to make it shallower.

Figs. 2, 3. Muscles moving the pinna as a whole: *a*, to raise it; *b*, to draw it forwards; *c c*, to draw it backwards; their insertion at *e* (fig. 3).

Figs. 4-7. Bony labyrinth or internal ear. Fig. 6: *a* is placed on the vestibule; *b*, fenestra ovalis; *c g*, the cochlea; *g*, its summit; *d*, superior; *e*, inferior; *f*, exterior semicircular canals. The figure shows a mould of the left labyrinth. Fig. 7 shows a section; fig. 4 a view of the right labyrinth, the cochlea removed and the vestibule thrown open; fig. 5, a shallower section cutting through the cochlea.

Fig. 8. Bones of the middle ear or tympanum: A, hammer; B, anvil; C, os orbiculare; D, stirrup; *a b*, head; *c*, long process; *d*, short process; *e*, handle of the hammer; *f*, body; *g*, short, *h*, long process of the anvil; *i*, head; *l k*, limbs; *m*, foot of the stirrup (*m* filling up the fenestra ovalis); and *d e*, the handle of the hammer resting on the tympanic membrane through its whole length.

Fig. 9. The bones *in situ*: *a c*, hammer; *d*, anvil; *b g k*, &c., petrous portion of the temporal bone; *e*, stirrup resting on fenestra ovalis; *h*, vestibule; *i*, first turn of the cochlea; *k*, mastoid cells; *f g*, ligaments of the bones.

Fig. 10. The cochlea: *a*, the modiolus; *b*, the bony lamina spiralis; *c*, the basilar membrane—for clearness' sake the membrane of Reissner, which forms a Δ with the basilar, whereof the apex is at the lamina spiralis and the base on the outer wall of the chamber, is not shown; *d*, the scala vestibuli; *e*, the scala tympani; *f*, the hamulus or point of junction of the scalæ.

Fig. 11. General view of the (left) ear: *a*, external ear; *b*, external auditory meatus; *c*, tympanic membrane or drum-skin; *d*, fenestra ovalis (in cavity of tympanum); *e e*, Eustachian tube; *f g h*, ampullæ of semicircular canals (*k l*); *k*, the vestibule; *m*, the cochlea (the letter being placed at the entrance of the auditory nerve to the inner ear). The pointed styloid process is seen below, and to its right is the mastoid process.

EARL. The title of earl or count (in Lat. *comes*) is the most ancient and widely spread of the subordinate or subject titles. It is derived from *ealdorman*, or chief magistrate of the shire, of the Anglo-Saxons, and from *jarl* of the Danes. Historically (but not actually) it answers to the French *comte*, to the Spanish *conde*, and to the German *graf*, under which title are included several

distinct degrees of rank—landgraves or counts of provinces, palsgraves or counts palatine, markgraves or counts of marches or frontiers (whence marchio or marquess), burggraves or counts of cities, counts of the empire, counts of territories, and several others.

After the battle of Hastings, William the Conqueror having annexed the feudal hereditary title of earl to the counties of the Saxon earls (with whom the title was only official), granted them to his principal captains. In this manner was the honourable title deprived of its administrative functions, except as to the counties palatine.

These earldoms were of three kinds, all of which were by tenure. The first and highest was where the dignity was annexed to the seisin or possession of a whole county with "jura regalia." In this case the county became a county palatine (*palatinus*, *i.e.* appertaining to the royal palace or dignity, the holders in many things being sovereign, holding courts, &c., subject only to the king himself) or principality, and the person created earl of it acquired royal jurisdiction and seigniory. The object of this great authority was that the earl should not be hampered in the frequent emergencies which arose, for the counties palatine were those which bordered on an enemy's country. Such were Chester, still existent (with Pembrokeshire until 1536), against the Welsh; Durham, under its bishop (till 1836), and Hexhamshire, under the Archbishop of York (till 1571, when it was merged into Northumberland), against the Scots; and Lancaster, belonging to the crown since the time of Henry IV. After the Conquest Kent was a county palatine under Odo, bishop of Bayeux, but when Odo fell its character of palatine was not renewed. So was the Isle of Ely from 1100 to 1538, under the bishop. The second kind of earls were those whom the king created earls of a county, with civil and criminal jurisdiction, with a grant of the third part of the profits of the county court, but without giving them actual seisin of the county. The third kind was where the king erected a large tract of land into a county, and granted it with civil and criminal jurisdiction to be held *per servitium unius comitatûs*.

Under the early Norman kings all earls, as well as barons, held their titles by the tenure of their counties and baronies; but with the solitary exception of the earldom of Arundel earldoms by tenure have long since disappeared, and in late times the title has been conferred by letters-patent. Earls have now no local jurisdiction, power, or revenue as a consequence of their title, which is no longer confined to the names of counties or even of places, as for example Earl Grey, Earl Russell, &c. In point of dignity the earl is between the marquis and the viscount. He is spoken to as "My Lord," addressed by letter as "The Right Honourable the Earl of ——," and by the crown as "Our right trusty and well-beloved cousin." His wife is styled a countess. His eldest son takes by courtesy the father's second title, which is usually that of "Viscount," while his younger sons are styled "Honourable," and his daughters "Lady," before their personal names. The coronet of an earl consists of a circle of gold, with eight spikes, each surmounted by a pearl, and strawberry leaves between the spikes.

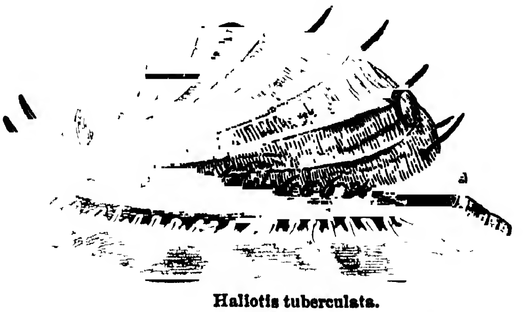
The number of earls in the House of Lords in 1884 was 137, not including the Scotch and Irish representative peers. The most ancient existing earldom is that of Arundel, created in 1189 by Stephen, and now held by the Duke of Norfolk. The oldest English earldom, not thus merged in another title, is the earldom of Shrewsbury, created by Henry VI. in 1442.

EARL-MAR'SHAL, an office of great antiquity in England, originally conferred by royal grant in the reign of Richard II., but now and since the time of Charles II. hereditary in the family of the dukes of Norfolk. The earl-marshal is the head of the College of Arms or Heralds' College, and presides at all great court ceremonies. He is the seventh great officer of state, taking precedence next after the lord great chamberlain, and before the lord steward of the royal household.

EARLY ENGLISH STYLE, in architecture and decoration, the purest, and in many respects the best, period of English Gothic architecture. It succeeded the heavy Norman style at about the close of the reign of Henry II. (1189). Its proportions were altogether more slender, walls higher, roofs steeper, &c., and for the round-headed doorways and windows of its predecessor it substituted the narrow-pointed windows of lancet-shape, often many lancet windows being clustered together as lights of one great window. For the heavy Norman pillars and zigzag decorative ornament, Early English substituted elegantly grouped and clustered pillars and fine mouldings, the hollows often filled with the "dogtooth" ornament or with carvings of leaves and flowers. As the period closed, tracery began to appear in the windows, mouldings became richer and deeper, carving more profuse, and about the death of Edward I. (1307) it passed into the "Decorated" style. Fine examples of the Early English style are to be found still among us, such as Lincoln Cathedral, especially the presbytery at the east end, and the choir of Westminster Abbey; and Early English traceried windows are well shown in the great east window of Lincoln. (Contrast this window in our Plates on ENGLISH CATHEDRAL ARCHITECTURE with the Decorated window from York beside it. See also the section of the Early English nave of Lincoln, in the same Plates.) A very fine five-light Early English window in York Cathedral is called the "five sisters." This cathedral, as a whole, belongs to the Decorated style.

EARRING, an ornament hung from a hole perforated for that purpose through the lobe of the ear, sometimes set with pendent jewels, pearls, or other precious stones. In the Latin of the middle age earrings are termed *pendentes*, from the more common form of the ornaments usually attached to the ring itself. Indian women (and men also) frequently wear jewels in the helix or outer curve of the ear, but such jewels are usually fixtures and lie close to the flesh. Other Orientals follow the same custom.

EAR-SHELL (Haliotis) is a genus of MOLLUSCA belonging to the class GASTEROPODA. The shell is ear-shaped, with a small flat spire, and has a very wide and in many cases a highly beautiful and iridescent aperture.



Haliotis tuberculata.

There is no operculum. The outer lip is characterized by a spiral ridge with a series of round holes in front, which become gradually filled up behind as new ones are formed. The outer surface is in general very rough, wrinkled, or tubercular and dull. The animal has a very large and rounded foot, with which it clings to the rocks like a limpet.

All round its foot to its mouth there is a double membrane cut out into leaflets and furnished with a double row of filaments. On the outside of its long tentacles are two cylindrical stalks for carrying the eyes. The mantle is deeply divided on the right side, and the water, which passes by means of the holes in the shell, can, through this slit, penetrate into the branchial cavity; along its edges again are three or four filaments, which the animal can also cause to come out through these holes. The mouth is a short proboscis. The species are numerous, upwards of seventy-five having been described, and are widely distributed, some being found in the Channel Islands, the Mediterranean, and the Canaries, while many others are found in India, China, the Cape of Good Hope, Australia, New Zealand, the Pacific Ocean, on the Coast of California, and as far north as Kamtchatka. They are remarkable for the beauty and diversified colours of the shells, and from the splendidly iridescent nacre they possess are much used for inlaying papier-maché and other ornamental works in which mother-of-pearl is employed. Large quantities are brought to Birmingham for that purpose. Some species supply a by no means indifferent article of food. The common ear-shell of the Channel Islands—the "Ormer," as it is there called (*Haliotis tuberculata*)—is largely used at the seasons when it leaves deep water and comes to the rocks laid bare at low tides. Great quantities are then taken, and when well beaten to make them tender, and after that properly dressed, they afford an excellent dish, tasting like veal cutlets. It is also eaten in Japan.

EARTH. Viewed in its place as a member of the SOLAR SYSTEM the Earth is a planet of moderate size and of intermediate position. Mercury, Mars, and the host of minor planets are all much smaller than the Earth. Venus is about the same size, while the great planets, Jupiter and Saturn, Uranus and Neptune, are vastly greater. So also Mercury and Venus revolve in orbits much closer to the Sun than the Earth's orbit, while all the other planets we have mentioned have orbits and periods exceeding those of the Earth. [See PLANET.] The shape of the Earth is approximately spherical, for the irregularities on the surface are inconsiderable in comparison with the Earth's stupendous bulk; more accurately, the sea-level is found to be an ellipsoid of revolution, and if a be the equatorial semiaxis and c the polar semiaxis we have by the most recent determination ("Geodesy," by Colonel A. R. Clarke, C.B., Oxford, 1880, p. 319)—

$$a = 20{,}926{,}202 \text{ feet.}$$
$$c = 20{,}854{,}895 \text{ feet.}$$

It has been thought that the shape of the Earth could be represented with still greater accuracy by regarding it as an ellipsoid with three unequal axes, in which case the same authority gives (p. 308)—

Equatorial semiaxis,	major	$a = 20{,}926{,}629.$
"	" minor	$b = 20{,}925{,}105.$
Polar	"	$c = 20{,}854{,}477.$

The axis major of the ellipse in which the Earth intersects the plane of the equator meets the Earth's surface 8° 15′ W. from Greenwich. It is, however, necessary to add the caution given by Colonel Clarke, when he says—"On the ellipsoidal theory of the Earth's figure, small as is the difference between the two diameters of the equator, the Indian longitudes are much better represented than by a surface of revolution. But it is nevertheless necessary to guard against an impression that the figure of the equator is thus definitely fixed, for the available data are far too slender to warrant such a conclusion."

The ellipticity of the Earth, or the fraction $\epsilon = \frac{a - c}{a}$, can be determined both by actual surveying measurements and by calculations derived from pendulum experiments; from the former we have $\epsilon = \frac{1}{292{\cdot}98}$, and from the latter $\epsilon = \frac{1}{292{\cdot}2}$.

Various attempts have been made to determine the mean density of the Earth. Newton, from theoretical considerations, estimated the density to be between five and six times that of water. Although several methods have been suggested and tried, there is still considerable uncertainty about the value of this important constant. Carlini, by pendulum experiments on Mount Cenis compared with those at the margin of the sea, found as low a value as 4·39; while Airy, by experiments in Harton coal-pit, found as high a value as 6·566. The value most usually adopted is 5·67, being the result found by Baily from torsion experiments, conducted with the most extreme care. The mass of the Earth, on this assumption, is 6×10^{21} tons. For astronomical purposes we require to know the relative masses of the Earth and the Sun; if we assume the latter to be unity, then the definitive value assigned to the Earth's mass by Leverrier is $\frac{1}{324439}$.

The Earth rotates on its axis in one sidereal day, equivalent to 23 hrs. 56 min. 4·0906 sec. of mean solar time. The actual shape of the Earth as an ellipsoid of revolution is intimately connected with the rotation of the Earth on its axis. Conceive a straight line drawn from the centre of the Earth to the north pole of the celestial sphere—*i.e.* the point on the heavens which remains unaltered during the daily rotation. This straight line intersects the Earth in a point which is thus defined as the north pole of the Earth. By means of the surveying operations which have determined the actual figure of the Earth we are enabled to ascertain the point on the Earth's surface which is the extremity of the shorter axis of the ellipse by whose rotation the actual figure of the Earth can be produced. It will be noticed that the apparent diurnal motion is quite unconnected with the purely surveying operations, so that it is extremely remarkable to find that the north pole of the Earth is very close to, if not actually identical with, the extremity of the shorter axis of the ellipse. Thus we see that the axis about which the Earth rotates, and which is determined by purely astronomical observations, coincides with the shortest diameter of the Earth, as found by mere terrestrial measurements. In this we have a very forcible illustration of the reality of the Earth's rotation. It is generally believed that at some very remote epoch the Earth was in a fluid or a semifluid condition. At that time the effect of the centrifugal force would make the Earth bulge out at the equator, and flatten it down at the poles, and thus shape the Earth to the form of an ellipsoid of revolution. The shortest axis of this ellipsoid would then coincide with the axis of rotation, as we actually find to be the case. For other phenomena connected with the rotation of the Earth see PRECESSION and NUTATION.

EARTH-NUTS are either the fruit of certain plants which bury it below the ground after the flowering is past, as the *Arachis hypogæa*, *Lathyrus amphicarpos*, and others, or else the subterranean tubers of fleshy-rooted plants, such as *Carum bulbocastanum*, *Lathyrus tuberosus*, and the like.

EARTH'QUAKES are the most terrific of all natural phenomena. The solid surface of the globe is put in motion by them, and in some cases may be compared with the sea when agitated by the wind.

The least dangerous of these phenomena are those which by the Creoles of South America are called *temblores*, a term which may be translated by *tremors*. The surface of the earth is put in a trembling motion, by which such objects as are not well supported are thrown to the ground, and even walls are split, but the damage does not extend further. These tremblings are by far the most common kind of earthquakes, and occur in some countries of South America, especially in Chili, almost every day, at least in certain seasons. See also EARTH-TREMORS.

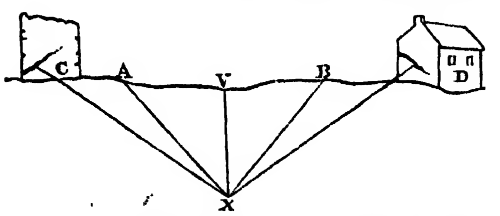
The *terremotos* of the Creoles, or earthquakes proper, give to the surface either horizontal oscillations, not dissimilar to the waves of an agitated sea, or they consist in violent perpendicular upliftings, so that it would seem as if repeated explosions were exerting their force against the roof of a subterraneous cavern. By these earthquakes walls are overthrown and fissures are produced in the ground. The latter are frequently more than a foot in width, and sometimes scalding water gushes out of them like a fountain. They are generally preceded and sometimes attended by a subterranean noise, which may be compared to the echo of distant thunder in a mountainous country.

Considerable changes may be produced on the surface of the globe by earthquakes. The coast of Chili has undergone a considerable change by earthquakes during the last half century. In 1825 the island of Santa Maria (near 37° S. lat.) was upheaved 9 feet, so that the southern port was almost destroyed, and the soundings round the island were diminished a fathom and a half.

The single shocks of an earthquake last from a few seconds to two or three minutes. Sometimes they follow one another at short intervals. Sometimes they are continued for several days, and even weeks; and in Chili, as said above, they are of daily occurrence. In 1850 a calculation was made of the number of separate earthquakes recorded (exclusive of such slight tremors as those just mentioned); it was found to amount to over 6000. But there must have been many more, for but few records of the earlier periods have survived.

Earthquakes are sometimes experienced over an immense tract of country. The earthquake in Chili in 1835 was felt at all places between the island of Chiloe (40° S. lat.) and Copiapo (27° S. lat.), and from the island of Juan Fernandez to the town of Mendoza, on the east side of the range of the Andes. It consequently extended over thirteen degrees of latitude and ten degrees of longitude. The earthquake in Peru and Ecuador in 1868 had a still wider area, spreading over not less than twenty-four degrees of latitude. But when earthquakes extend over such an immense tract of country some districts are always convulsed with greater violence, and these may be considered as the centre of the earthquake.

The movement of an earthquake seems like a wave starting from such a centre of disturbance and travelling through the earth's crust. The direction of the fissures in buildings is naturally somewhat near the perpendicular to the thrust of the earthquake. Let X be the subterranean centre. Then the tower and house, C D, will be thrust outwards by the shock; if all the parts of the building do not return equally a fissure occurs, and this fissure, by the nature of the case, must be at right angles, or nearly so, to the direction of the shock. Also X V is the shortest



line from X to the surface, and is called the seismic vertical; X A, X B (V A being equal to V B) are coseismics, and will have simultaneous shocks; so also X C, X D. But the latter will be shaken some time *after* the points A B, as X C is longer than X A, &c. By combining these two sets of observations the position of the central point of disturbance is found. The earth-wave, formed by the successive elevation of coseismic points in successive circles from the seismic vertical, is accompanied by an air-wave, which is the cause of the low rolling thunder-like sound generally observed. And where the disturbance reaches the coast by two sea-waves, the first and lesser of the sea-waves accompanies the earth-wave, going at the same rate as the latter; the second goes much more slowly, and is often a considerable time after the earth-wave in its arrival at any given point. The rate at which an earth-wave travels will depend on the nature of the rocks composing the country which it traverses; there may even be widely different rates for one and the same wave in different directions. Thus the earthquake of Viège (1855) travelled northwards at 2861 feet, southwards at 1898 feet per second. An earthquake at Travance (in Hindustan) was observed to travel at the rate of 656 feet per second; the earthquake of Central Europe in 1872 had a rate of 2433 feet per second. Not only the rate of progression, but the amount of injury done depends greatly on the nature of the rock in a disturbed district. Thus during the earthquake at Port Royal (Jamaica) in 1692, the houses built upon sand were completely destroyed, while those built upon limestone escaped. Earthquakes vary greatly in duration, some consisting of only one wave or shock, some of a more or less rapid succession of them. The great earthquake of Caracas lasted half a minute, that of Lisbon five minutes. But cases, as already stated, have been known where shocks have succeeded each other constantly for weeks. The extent of the district affected by an earthquake also varies very greatly; sometimes it is only a few square miles, while that of Lisbon (1755) extended over about 15,000,000 square miles. The usual depth of the point of disturbance of an earthquake is at most 30 miles, and often very much less. The depth in the case of the earthquake of Herzogenrath (1873) was 14·5 miles; that of 1872 (in Central Europe), 9·6 miles; that of Belluno (1872), 4 miles. Both the intensity and the frequency of earthquakes differ greatly at different parts of the earth's surface. The basins of the Mediterranean and Black Seas; the west coast of South America, running upwards through Central America to Mexico; and the great islands between Asia and Australia, may be mentioned as districts in which earthquakes are both frequent and severe.

The action of earthquakes is not confined to those districts in which their effects are at once outwardly perceptible, for even where they have no active vent the law which regulates them is believed to be always in operation, it being supposed by the most eminent seismologists that earthquake regions around a volcano, and earthquake regions apparently disconnected from any outlet, differ only in this respect, that in the one case the subterranean forces have had sufficient power to produce the phenomena of eruption, while in the other they have not. "In earthquakes," says Humboldt, "we have evidence of a volcano-producing force; but such a force as universally diffused as the internal heat of the globe, and proclaiming itself everywhere, rarely acts with sufficient energy to produce active eruptive phenomena; and when it does so, it is only in isolated and particular places."

It is worth noticing that so far as the future history of our race is concerned, it would be a far more serious misfortune if the earth's subterranean forces were gradually to become extinct (as some have thought they are tending to become, following in this what seems to have been the history of the moon), than it would if they were to increase in energy within a moderate limit. In the latter case, indeed, many more lives would be lost, and a far greater amount of property would be destroyed; but in the former case the earth would simply become uninhabitable.

If the solid substance of the earth formed a perfect sphere in ante-geologic times—that is, in ages preceding those to which our present geologic studies extend—there can be no doubt that there was then no visible land above the surface of the water. In this state of things nothing but the earth's subterranean forces could tend to the production of

continents and islands, and it is quite certain that when once continents and islands were formed, there immediately began a struggle between destructive and restorative forces. The great enemy of the land is water, and water works the destruction of the land in two principal ways, by the action of rain and by the eating away of the sea-coasts by the sea.

We see, then, the necessity that exists for the action of some restorative or preservative force sufficient to counteract the effects of the continuous processes of destruction of the land by water in these two ways. This action is supplied by earthquakes, and so beneficial have been the results that Sir John Herschel says, that "had the primeval world been constructed as it now exists, time enough has elapsed, and force enough directed to that end has been in activity, to have long ago destroyed every vestige of land, if no restorative agency had been in operation."

Nor is this preservation of land by earthquakes all. It would be impossible to overestimate the value of the services of earthquakes in storing up for us materials on which we largely depend for our comfort, and even for our very existence. But for them the coal we burn would never have been compacted, and so fitted for our use; the soils of various character from which our forests and our fields derive their nourishment would have had no existence; the very materials from which we build our houses would either have been wholly wanting, or would have been less perfectly adapted to our requirements. Not less important is the influence of the earth's subterranean activity in modifying the forms of continents, in affecting the direction of the great mountain chains, and in regulating the distribution of land and water. Even the climate of a country owes its character to long-past earth-throes.

Perhaps the question which most importantly affects us is neither that of the gradual dying out of subterranean actions, nor that of their ultimately becoming sufficiently powerful to affect the earth's destruction. Each of these views may be looked on as wholly speculative, since we have no evidence whatever in favour of either. But although we may be satisfied that, to use the words of Sir Charles Lyell, "the energy of subterranean movements has always been uniform as regards the whole earth," and therefore that it will probably continue so, yet we must at the same time recognize the possibility that regions which are now the scene of intense subterranean activity may one day be comparatively at rest, and that regions now at rest (as England, for example) may one day become in turn the great theatre of subterranean action. We cannot, says Lyell, found the opinion of our continual immunity from the effects of destructive earthquakes on the fact that "they may for a cycle of years have been invariably confined, as at present, to large but determinate spaces." The whole evidence of geology goes to show that regions now at rest have once been violently disturbed during a long series of ages, and that most of those now disturbed have in old times been at rest.

We are not used to think of England as suffering from earthquakes; but besides the famous "pill for the earthquake," gravely advertised in 1750 (as we know from Horace Walpole), along with "earthquake gowns" to protect ladies afraid to stay within doors at night, showing the universal dread of a repetition of some shocks felt that year, we have at least 300 well-recorded English shocks. Of these the most severe are the earlier ones, and in all the wave has uniformly travelled from south-west to north-east, indicating the neighbourhood of the Cape Verds and the Azores as the probable origin of disturbance; a region to which the fatality of Lisbon (in 1755) is also set down. Roger of Wendover gives the first record, in 974, of a serious and tolerably universal earthquake. Then follows one in 1081 with "heavy bellowing throughout all the land," and in 1089, says the English Chronicle, came "a mickle earth-stirring all over England." In 1110 the bed of the Trent was dry for a whole morning (Chronicle of Florence of Worcester); and in 1133 came another earth-throe. The great earthquake recorded by Matthew Paris, which rang the bells all over East Anglia and threw down men and women, was in 1165. Still worse, though more restricted in its area, was that of 1185, when Lincoln Cathedral was completely wrecked; and in 1187 further mischief of the same sort accrued. In 1247 Matthew Paris records a considerable earthquake, throwing down buildings in London, &c., and followed by an apparent cessation of the tide for three months. The chronicler is very accurate, or one would at once disbelieve the possibility of the latter phenomenon. Wells Cathedral tower was thrown down, and the churches of all that region damaged, in 1248; and this stormy epoch was closed by the worst outbreak of all, in 1275, churches falling and houses overthrown all over the land. During this period Vesuvius and its district seem to have been quiescent; but in 1302 began the great lava flow at Ischia, breaking the silence of fourteen centuries, and this relief probably gave rest to England. In 1382 much damage was done by an earthquake in the south-east of England, but that is the last serious disturbance we have had. In 1580 part of the Temple church was thrown down and stones fell from St. Paul's; and Walpole's earthquake of 1750 has been already spoken of. Since then the effects of the earthquake at Lisbon have been among the worst felt in England, and these reached so far north that Loch Lomond rose and carried a boat 40 yards inland, while the Tay swept away the women washing on its brink with its sudden wave. During the present century 200 English earthquake shocks are recorded, all slight except that of 13th August, 1816, when numbers of the Inverness folk were flung out of bed, and much of the town was damaged, all Scotland more or less feeling the shock.

As for recent earthquakes, that of Ischia on the 28th July, 1883, nearly ruined the little Italian island. Ischia had had a severe shock in March, 1881, when 180 people perished; but the earthquake of 1883 destroyed nearly every building in Casamicciola and the neighbourhood, and sacrificed nearly 5000 lives. King Humbert himself in person urged on the relief-parties, so great was the distress and suffering. But hardly had men recovered from the shock before the most stupendous earthquake on record occurred in Java on 26th August, 1883 and two following days. Java itself was much damaged, the navigation of the straits of Sunda entirely altered, and for a time blocked up, one considerable island shattered and sunk, and to compensate for that sixteen others raised above the water. Not less than 100,000 people perished, either buried beneath debris or swept off by the terrific wave which raged along the whole face of the sea-shore. The floor of the Southern Ocean, over a wide area to the south-east of Sumatra, was raised into a plain above the waters, and the effects of the general upheaval were felt as far as the American Pacific coast. Severe earthquakes took place at Charleston, South Carolina, in 1886, and on the Riviera, chiefly in the Italian portion, in 1887. In both these outbreaks serious loss of life took place.

The received opinion as to the cause of earthquakes is very simple in theory. The radius of the earth is roughly 4000 miles, and as the temperature is found to increase a degree Fahrenheit with every 60 feet of depth (so that at 2 miles water would boil, and at 3 or 4 miles every known rock would fuse), the heat of the central regions is beyond all conception. But the earth is, as a whole, as rigid as steel, though the crust is far less rigid than that. The consequence is that the intense pressure suffices even against the intense heat to keep the core of the earth solid. As the earth radiates it wrinkles much as an apple does in drying, and thus crumples up what were horizontal strata into our hills and valleys, and in the deepest valleys

of all lies the sea. But the upward or anticlinal curves of this titanic folding release the soil beneath them, and this at once springs into fluidity, a mass of molten rock lying ready for action. The lava caverns for Europe at the present day must be larger in area than the Mediterranean, since Palmieri has detected lunar tides in the funnel of Vesuvius, and every one knows that the Mediterranean is not large enough to give an appreciable tide. But another result follows. It is evident that just the point where the synclinal and anticlinal curves meet is the point of greatest strain, and that also is likely to be the sea-level. Let but a rent occur there, or in the sea-bed, and the water penetrates to the lava-caverns in the interior of the earth. Huge masses of steam, or of water heated beyond steam-point under pressure, are generated, and these heave beneath the earth till they either find relief in an earthquake, which raises the roof of their prison, or get ven up the pipe of a volcano or a geyser, when they send up lava (molten rock and water mixed) in the one case and boiling water in the other. A glance at the map will show the centres of volcanic (and earth-shaking) activity to be along the sea-shores in nearly all cases, and consultation of other records will show that active volcanoes are invariably on rising coasts. Occasionally, however, earthquakes are caused by the caving in of the roofs of empty caverns of this description. The two Ischia earthquakes of 1881 and 1883 were so caused. The thrust was downwards in this instance, and the focus was very near the surface, probably within a few hundred feet, so that the area of injury was very small, the angle of emergence rapidly diminishing as one receded from the seismic vertical. Also no effect was observed on Vesuvius, as must have been the case if the usual cause had prevailed. In this connection it may well be remarked that the final phase of the history of a volcano is the subsidence of its cone into the caverns it has emptied during its activity. But it is fair to add that an important minority of seismologists regard the Ischian earthquakes as volcanic and not subsident, basing their theories chiefly on the small changes of level that have occurred. Our own Goodwin Sands, off Kent, are the result of a subsidence on a somewhat large scale; and many other instances are not wanting—nevertheless the enormous majority of earthquakes arise not thus, but in the manner mentioned above.

EARTH'SHINE is the faint light seen on the surface of the moon at the part not illuminated by the sun, just before or just after new moon. (Astronomers consider this is light reflected from the earth, which must be a very bright object from the moon; since her disk would at that time show to a lunar inhabitant, if there were one, thirteen times the size that the moon's disc shows to us.) Country folk say at such times that the "old moon lies in the new moon's arms;" and it is curious to observe that the "old moon" seems part of a smaller circle than the thin crescent of the "new moon," through the tendency of brilliant bodies to seem larger than they are, called *irradiation*.

EARTH-TREMORS and **OSCILLATIONS.** The first are a sort of almost constant pseudo-earthquake, possibly, though not certainly, due to the same causes as that world's terror. [See EARTHQUAKE.] The crust of the earth is in a state of constant movement. When these movements are sudden and violent we call them earthquakes; transient shiverings, which require the aid of instruments to make them visible, we call earth-tremors; movements of longer period and greater amplitude, causing large areas, like islands and continents, to rise and fall like rafts upon the ocean, are called oscillations.

Mr. George Darwin, son of the illustrious CHARLES DARWIN, while endeavouring to measure the lunar disturbance of gravity, found that even in Britain we have a soil which is subject to storms of microscopic earthquakes. These earth-tremors were so numerous and of such a magnitude that they eclipsed the results which were being sought for, and the problem (of experimentally measuring the pull exerted by the moon) had to be relinquished. The mountains and plains on which we dwell are in a state of perpetual vibration. Further, Mr. George Darwin has shown us that an increase in barometrical pressure over an area is equivalent to loading that area with a weight in consequence of which it would be depressed. Sir William Thomson likens this phenomenon to placing a pile of sovereigns on a mass of jelly. It is proved that a rise of 1 inch in the barometer over a surface as large as Australia would be sufficient to sink it and the ocean surrounding its shores 2½ inches.

When these loads are removed the depressed area rises, and an oscillation of the earth's crust has been completed. Earth-tremors have been unnoticed by ordinary observers, because the amplitude of their motion was so small; oscillations like these have been overlooked because the period of their vibration is so long. Whether movements analogous to these, which may be caused by atmospheric pressure and which are of great amplitude and long duration, exist in nature is at present to some extent problematical. That they exist and have a connection with many phenomena which are at present unintelligible is not improbable. Among these phenomena may be mentioned the abrupt oscillation in the levels of water which from time to time have taken place in inland lakes. Thus we have the *seiches* and *ruhssen* of Switzerland in lakes like Geneva and Constance, where the waters, for reasons without definite explanation, rise suddenly through a distance ranging from a few inches to a yard. The like phenomena exist in the Baltic, in the great lakes of America, and probably all over our globe. (Final Report of Committee to British Association, 1882: Messrs. G. H. Darwin, Horace Darwin, Sir W. Thomson, &c.)

EARTH'WORKS, in fortification, are employed both in connection with permanent works and in field operations. The most ordinary form is the parapet excavated from a ditch in front or from a trench behind. Most military engineers now advocate the use of earthworks in the construction of forts in preference to masonry, and have advanced powerful arguments in support of this theory. Thus it has been urged that earthworks are cheaper, more easily thrown up, can be readily repaired, and are safer for the defenders from the absence of dangerous splinters of stone during a bombardment. The obstinate defence made by the Russians behind the earthworks of Sebastopol is well known, and the equally obstinate defence of Plevna by the Turks against the Russian army in 1877 showed what may be done by the aid of hastily constructed works of this description. At the bombardment of Alexandria by the British fleet in 1882 it was found that while the projectiles from the heavy guns of the ironclads quickly reduced the masonry walls of the forts to ruins they had but little effect upon the earthworks against which they were fired. Shelter trenches and banks of earth thrown up as defences against small-arm fire are now used on every possible occasion in warfare, and light intrenching tools now form part of the field equipment of every regiment.

EARTH'WORM, a name applied to many species of the OLIGOCHÆTA, an order of ANNELIDA, but specially to the genus Lumbricus, of which the common earthworm of our gardens, *Lumbricus terrestris*, is an example. The body is long and cylindrical, made of a number of rings or segments, each of which, with a few exceptions, is, both in external appearance and internal anatomy, like its fellow. The anterior end is pointed. The mouth is large, and placed in the first segment, and overhanging it is a little lobe (*prostomium*), which is a rudimentary head. The whole body may be regarded as a colony, built up like the colonies of polyps, such as the SIPHONOPHORA, of a number of persons, some of which may be specialized to perform certain functions for the good of the community. But as the per-

sons or segments are placed one after the other in regular succession, all after the first are incomplete, having no mouth nor prostomium. In the case of the earthworm there is no assertion of the individuality of each segment. If cut in two the head part grows, but the tail dies. In a nearly allied genus, Nais, after a certain number of segments has been produced, the cohesion of the chain fails, a segment near the middle of the body acquires a mouth and a prostomium, and the body is divided into two, both halves being perfect animals. In Ctenodrilus the process goes still further, for under certain circumstances the body completely breaks up, and every segment develops a mouth and a prostomium. In all these animals growth goes on between the penultimate and the last segment. The earthworm has no external organs except minute bristles, of which there are eight on every segment, arranged in four pairs. These bristles are mainly organs of locomotion. They are of a horny nature, and are produced by cells lying in follicles of the epidermis. The body consists of about 120 segments. The hinder end is flattened and broad; the anus is placed on the ventral surface of the last segment. At the fifteenth segment occur the male genital apertures, and in the anterior segment a much smaller pair are found, which are the apertures of the female genital organs. Though the sexes are thus united in one animal self-fertilization never takes place. The union of two individuals is effected by means of the *clitellum*, a broad thickened belt, developed only when the generative organs are ripe, and produced by great elongation and multiplication of the cells on the surface of the body. It occupies six or eight segments, and begins at about the twenty-eighth or thirtieth segment. The genital products of another worm are received in special receptacles (*spermathecæ*), which are four large sacs situated between the ninth and eleventh segments. The position of the genital apertures varies in different genera of Oligochæta; in some they are placed in the clitellum, in others after it, and in Lumbricus alone before it.

The digestive system is well developed. The mouth leads into a powerful pharynx, which is pushed forward when the animal eats. A straight œsophagus follows, dilated in the eleventh and twelfth segments into three pairs of glands, which contain a secretion of carbonate of lime, and again from the sixteenth to the eighteenth segment into a "crop" or *proventriculus*. A gizzard, worked by powerful muscles, and taking the chief part in the trituration of food, occupies the nineteenth and twentieth segment. The gizzard opens into a straight intestine continued throughout the rest of the body to the anus. There is a vascular system, consisting of a dorsal contractile vessel running right through the body and forming a network on the pharynx, together with eight pairs of lateral vessels, the so-called hearts, situated from the eighth to the fifteenth segments. These vessels are filled with a red fluid containing colourless corpuscles. Respiration is carried on by the skin. The nervous system consists of two central cerebral ganglia above the pharynx, and ganglia lying throughout the body below the alimentary canal, one in every segment, united by cords. Though earthworms are destitute of eyes, Darwin has shown that they are not insensible to light. Light acts, however, only on the part of the body where the cerebral ganglia lie, and affects them by its duration and intensity. When their attention was engrossed by eating or dragging leaves into their burrows Darwin found that they were quite regardless of the most intense light. The *nephridia* or "segmental organs" are long coiled tubes, one of which occurs in every segment. They are excretory in function, and open into the body-cavity by a ciliated funnel-shaped aperture. The segments are divided one from another internally by a muscular diaphragm (*septum*).

Special attention was directed to the habits of earthworms by the publication of Darwin's work on "The Formation of Vegetable Mould through the Action of Worms" (London, 1881). This book shows how great a part these lowly-organized creatures play in the economy of nature. As is well known earthworms live in burrows in the earth, lying in the daytime near the surface, and at night crawling about, usually with their tails still inserted in their burrows. When they leave their burrows entirely, as they sometimes do, they are unable to find them again, and have to construct new ones. They line the upper parts of these burrows with leaves, filling up the interstices with stones, &c., to prevent their bodies from coming into close contact with the damp earth. They are almost omnivorous, feeding on leaves and vegetable matter, raw meat, &c. They swallow enormous quantities of earth, out of which they extract all that is digestible. They exude from their mouth a strong digestive fluid. Grains of sand and small stones are found in their gizzards and intestines, serving to triturate the food. The earth, with the indigestible portions of their other food, is ejected on the surface, forming the well-known heaps called castings; some foreign species form little towers of their castings on the ground, to the height sometimes of 3 inches. One of the most curious of their habits is that of protecting the entrance to their burrows. They often pile little heaps of stones over these. Their strength is extraordinary, for one stone dragged over a gravel-walk to the mouth of a burrow weighed 2 oz. Usually they plug the mouths of their burrows with leaves, petioles, sticks, &c. They show very great intelligence in the selection of the substances which they use as plugs, and in choosing which ends of them they shall seize and drag in first. They do not seize most leaves, for instance, by their stalks, which would seem most handy to lay hold of, but by their tips, because the leaves are most easily dragged down into the holes when thus introduced; but when the basal parts of the leaves are narrower than the apices they take hold of the stalks. Darwin made a series of most interesting experiments with triangles of paper and other objects, with the result of proving the marked intelligence exhibited by worms in this matter. The only well-developed sense earthworms possess is touch; they can hardly be said to see, are completely deaf, and have only a feeble sense of smell.

Darwin calculates that in many parts of England a weight of more than 10 tons of dry earth annually passes through the bodies of these animals, and is brought to the surface on each acre of land; so that the whole superficial bed of vegetable mould (for which the name *animal* mould would now seem more appropriate) passes through their bodies in the course of every few years. As the old burrows collapse, and fresh castings are brought to the surface, the whole layer of mould is subjected to a slow circulation, and the particles of earth are still further reduced in size. The decomposition and disintegration of the soil is further aided by the presence in it of the partially digested leaves, saturated with the secretions of digestion, which hasten the generation of humous acids. By the action of wind and rain this fine rich mould is spread over the surface of the earth. The burial of most of the remains of Roman villas and pavements scattered over the country, as well as of numerous other ruins, is shown by Darwin to be principally due to these animals, to whom he thinks archæologists ought to be grateful, seeing that they preserve their treasures, buried beneath their castings, for an indefinitely long time.

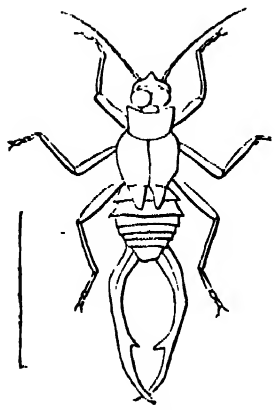
"The plough is one of the most ancient and most valuable of man's inventions; but long before he existed the land was in fact regularly ploughed, and still continues to be thus ploughed, by earthworms. It may be doubted whether there are many other animals which have played so important a part in the history of the world as have these lowly-organized creatures."

EAR-TRUMPET, an instrument employed to aid defective hearing, by collecting and concentrating the waves of sound, so that they may impinge upon the tympanum

with increased force. It is in principle the reverse of the speaking-trumpet. Many varieties of ear-trumpets are made, under the names of ***auricles***, ***ear-cornets***, ***ear-conches***, ***conversation-tubes***, and ***table-sonifers***, adapted to different requirements of partially deaf persons.

EAR'WIG is the name applied to a family (Forficulidæ) of insects forming a suborder of ORTHOPTERA. EUPLEXOPTERA. The name, like the French *Perce-oreille* and German ***Ohr-wurm***, is derived from the vulgar error that they are specially addicted to creeping into the human ear, an error which, while showing a great ignorance of the anatomy of the human auditory organ, has doubtless arisen from the habit of these insects of avoiding sunlight by creeping into holes and all sheltered places.

In this family the anterior pair of wings (*tegmina*) are horny or leathery and very short, and have a straight suture. They are disposed horizontally on the body. They are large enough nearly to cover up the very delicate hind wings, which are ample, and have many radiating nerves which act as the ribs of a fan, and besides their longitudinal, have transverse folds. In some species both wings and tegmina are deficient. A most remarkable character in these insects is the appendage of the last segment of the body, which consists of a large pair of horny forceps, most developed in the males, and in some species becoming very formidable weapons. These forceps are also used for arranging the wings under the short tegmina, much in the same way as some of the brachelytrous beetles, as the devil's coachhorse (Ocypus), use their flexible abdomen. The body is elongated. The jaws are short but strong. The eyes are small and round, while ocelli are absent. The antennæ are thread-like, inserted before the eyes, and vary considerably in the number of their joints.



Forficula brachynota.

Earwigs are very sensitive to sunlight; they conceal themselves in any hole or crevice during the day, and only come forth in the twilight or night. Their food usually consists of vegetable matters, fruits, and the petals of flowers, but some of them at least seem at times to lapse into carnivorous habits and even cannibalism. Earwigs undergo an incomplete metamorphosis, the larva resembling the perfect insect except in the absence of wings and wing-covers, the rudiments of which are attained by the pupa. The earwig displays the strong maternal solicitude for her young so common among birds, brooding over her eggs till they are hatched, and shielding the larvæ from danger under her body like a hen with her chickens.

The species of this family present a great uniformity of character; they are tolerably numerous and widely distributed. The common English Earwig (*Forficula auricularia*) has a long narrow body of a brownish colour; the antennæ have fourteen joints. Another common British species, the Little Earwig (*Habia minor*), is commonly met with on the wing; our common earwig, though it has never been observed, probably also occasionally makes use of its wings in flight.

EASEMENT. An easement is a right which the owner of one piece of land, sometimes called the dominant land, has in respect of his ownership, by virtue of which right the owner of another piece of land, sometimes called the servient land, is obliged to allow the owner of the dominant land to do something on the servient land, or something which has relation to that land, or is himself obliged not to do something on that land; and this power on the part of the owner of the dominant land, or this duty to forbear on the part of the owner of the servient land, must be something that is for the benefit of the owner of the dominant land.

Easements may be divided into affirmative and negative. Examples of affirmative easements are a right of way over a neighbour's land, or a right to discharge water through it, as in the case of a drain. An example of a negative easement is where the owner of land is prevented building on his own land or some part of it. Though the division into affirmative and negative easements is admitted by writers on English law, the different cases of easements are not always correctly referred to these two separate classes. There is a great number of these rights called easements, as many indeed as can exist by virtue of the contiguity of two pieces of land belonging to different owners, with or without buildings on them, and the convenience that may be derived to one piece of land or to one building from some limitation of the power of the owner of another piece of land or of another building over his land or building.

The term servitudes in the Roman law is much more comprehensive than the term easements; but the law which relates to the class of servitudes, called Urban and Prædial, comprehends most of the rules that are applicable to the doctrine of easements ("Dig." 8). The French law on servitudes, or ***services fonciers***, is contained in the "Code Civil," liv. ii. tit. 4.

Servitude in the law of Scotland may be taken as the equivalent of the English easement; but the rules applicable to such rights are very similar to the analogous provisions of the Roman law. Servitudes are distinguished into prædial and personal. Prædial are those constituted over one tenement, called the servient tenement, in favour of another called the dominant tenement; personal, those constituted over lands, &c., in favour of a person without reference to his possessing another tenement. The former are similar to what in England are called easements; the latter are limited to life-rent, terce, and courtesy. Prædial servitudes are either rural or urban, and are also distinguished into positive and negative. Positive servitudes are those in which the proprietor of the dominant tenement has power to do something affecting the servient tenement, which but for the servitude he could not do. Negative servitudes are those in which the servient proprietor is prohibited from doing something which but for the servitude he could do. Positive servitudes are constituted either by grant or prescription; negative servitudes, by grant only. See Rankin on "Land Ownership," p. 320.

EAST, the point of the compass which is in a direction at right angles to that of north and south, and which is towards the ***right*** hand of a spectator who faces the north. The distinction between east and west must ultimately be derived from a reference to the human body; for we can only define a spectator's ***right*** hand by saying that it is the hand which is not upon the same side as the heart. The derivation of the word is from the Anglo-Saxon ***eást***, akin to the German ***ost***, the last syllable of the Latin *aur-ora*, the Greek ***eôs***—all of them springing from the Aryan root $\sqrt{}$us, to burn, and meaning the "sunburst" or sunrise.

EAST ANGLIA and **EAST ANGLES.** The East Angles (the Angles who settled on the east coast, that is) formed their kingdom in the course of the sixth century, during the great English conquest of Britain. They came in two divisions, called from the position of their settlements in their new home the Northfolk and the Southfolk, our

Norfolk and Suffolk. About 870 the Danes made their first important inroad into East Anglia, and the native East Anglian kings came to an end with St. Edmund, king and martyr, who suffered for his Christian faith at the hands of the heathen Danes. (His freedom was offered if he would worship Odin.) Henceforth East Anglia formed part of the DANELAGH, and was formally recognized as such in the partition of the kingdom between Guthorm and Alfred the Great in 879. The greater Anglian kingdoms of Northumbria and Mercia retained their freedom. The large settlements of the Angles as compared with those of the Saxons and Jutes account for the land as a whole being called Anglia or England. Saxonia is, however, sometimes met with as a name for England. But Engla-land (Angle-land) and Englisc were from almost the very first the names of the whole people. Only the Celts called them Saxons. Rarely they called themselves Anglo-Saxons, *i.e.* Angles and Saxons.

EAST INDIA COMPANY. This association originated from the subscriptions of a few private individuals. It gradually became a commercial body with gigantic means, and next, by the force of unforeseen circumstances, assumed the form of a sovereign power.

The company was first formed in London in 1599, when its capital, amounting to £30.000, was divided into 101 shares. In 1600 the adventurers obtained a charter from the crown, under which they enjoyed certain privileges, and were formed into a corporation for fifteen years, with the title of "The Governor and Company of Merchants of London trading to the East Indies." The first adventure of the association was commenced in 1601, Akbar being the Great Mogul with whom the English merchants first opened relations; and this, as well as seven or eight subsequent voyages, yielded a commercial profit of 100 to 200 per cent. Even more profitable was the trading with the Spice Islands, Java, Sumatra, &c., but from this quarter the English were soon driven by the perseverance of the Dutch, whose monopoly was secured by the massacre of Amboyna in 1622. The charter was renewed for an indefinite period in 1609, subject to dissolution on the part of the government upon giving three years' notice to that effect. In 1611 the company obtained permission from the Emperor Shah Jehan to establish factories at Surat, Ahmedabad, Cambaya, and Goga. The capital was increased by a new fund of £1,600,000 in 1617. The functions of government were first exercised by the company in 1624, when authority was given to it by the king to punish its servants abroad either by civil or by martial law, embracing even the power of taking life. In 1682 a third fund of £420,700 was raised. The king encouraged the formation of a rival company in 1636, but the rivals coalesced to form a joint company in 1650.

In 1652 the company obtained from the Mogul, through the influence of a medical gentleman (Mr. Broughton), the grant of a license for carrying on an unlimited trade throughout the province of Bengal without payment of duties. An increase of capital, an extended charter, and a successful attempt to keep down a new rival company marked the next ten years.

The first territorial acquisition on the mainland of India was in 1639, when Fort St. George, now the citadel of Madras, was built on a narrow strip of land on the south-east coast ceded by a local prince. In 1661 the Island of Bombay, off the west coast of India, formed part of the dowry which Catharine of Portugal brought to her husband, Charles II. In 1668 the king made it over to the company, and in 1687 Bombay was recognized as the chief English settlement in India. It was not till 1700 that the first territorial possession in Bengal was obtained, the nabob having in that year granted to the company the ground on which Calcutta now stands. Such was the origin of the three great presidencies.

The first occasion on which the company was brought into collision with any of the native powers of India occurred in 1664, when Sevajee, the founder of the Mahratta States, attacked the city of Surat. The aid which the company's servants gave on this occasion to the inhabitants won for them the good-will of the Mogul; and the company gradually obtained increased power, both from the Mogul and from Parliament. In 1693 the company obtained a new charter by gross bribery of the highest officers of state; but the House of Commons refused to sanction it. Another new company was formed about the same time, and another amalgamation took place, which left the united company on the footing which it maintained from 1702 till 1833. The capital was gradually increased to £6,000,000, upon which dividends were paid until April, 1874.

The home government of the company consisted of—1, the court of proprietors; 2, the court of directors; and 3, the board of control.

The court of proprietors elected the directors of the company, declared the amount of dividend, and made by-laws. The votes of the proprietors were given according to the amount of stock which they possessed, ranging from one vote for £1000 and upwards. The number of proprietors was about 1900. The court of directors consisted of twenty-four proprietors elected out of the general body. The qualification was the possession of £2000 stock. Six of the directors went out of office every year; they retired in rotation, so that the term of office for each was four years. The directors appointed the governor-general of India and the governors of the several presidencies; but as these appointments were all subject to the approval of the crown they may be said to have rested with the government. The directors had the uncontrolled power of recalling any of these functionaries; and in 1844 they exercised this power by recalling Lord Ellenborough, the governor-general. The board of control was a government office, established in 1784, the duty of which was to superintend the territorial and political concerns of the company; to inspect all letters between the directors and their agents which related to those subjects; to alter or amend the despatches prepared by the directors; and in urgent cases to transmit orders to the functionaries in India without their concurrence.

The Act of Queen Anne gave the company exclusive trading powers to the East, which lasted with little alteration till 1813. In this year much of the trade was thrown open by a new charter for twenty years, that with China being, however, retained as a monopoly. In 1833 another renewal for twenty years was granted, which took away from the company the sole right of trading either to its own territories or the dominions of any native power in India or in China, and threw the whole completely open to the enterprise of individual merchants.

The company's nominal profits in the eighteenth century were very high; but as their trade was conducted in a costly way, and was burdened with military charges, it yielded little real profit. Private traders had always been able to outbid the company when allowed to compete. Thus, in the twenty years from 1813 to 1833 the value of goods exported by the private trade increased from about £1,000,000 sterling to £3,979,072, while the company's trade fell from £826,558 to £149,193. The impossibility, as thus shown, of the company's entering into competition with private merchants had a powerful influence with Parliament; and in the charter of 1833 the company was confined altogether to the territorial and political management of its vast empire. The dividend guaranteed by the Act of 1833 was £630,000, being 10½ per cent. on a nominal capital of £6,000,000. The dividends were chargeable on the revenues of India, redeemable by Parliament after April, 1874.

The executive government of the company's territories was administered at each of the presidencies by a governor and three councillors. The governor of Bengal was also the governor-general of India, and had a control over the governors of the other presidencies. The governors and their councils had each in their district the power of making and enforcing law, subject in some cases to the concurrence of the supreme court of judicature, and in all cases to the approval of the court of directors and the board of control.

Previously to the passing of the Act of 1823 the company possessed the power of arbitrary deportation against Europeans without trial or reason assigned, and British-born subjects were not only restricted from purchasing lands, but were prohibited from even renting them. Under this Act, however, this arbitrary power was materially limited.

Between 1767 and 1813 the company was liable to an annual payment to the country of about £400,000, in lieu of their extensive and rather anomalous privileges in the East. This tribute was very irregularly paid; and in 1813 it was abolished altogether; but provisions were at that time laid down which established the right of Parliament to assume possession of the company's territories at some future time. The company levied a land tax in all its possessions.

The revenue of the Indian government was not confined to its collections from the land, but consisted likewise of customs duties, stamp duties, subsidies, and tribute from certain native states. The dreadful Indian mutiny of 1857, with the horrors of Cawnpore, &c., aroused the nation to a sense of the impropriety of a private company holding so vast a state. Consequently in 1858 a bill was brought into Parliament for remodelling the government of India, and investing the political power entirely in the hands of the British sovereign and her ministers. The object of the measure was to remove the inconvenience of double government, the checks and counterchecks of which were frequently so multiplied as to paralyze immediate action. The alterations chiefly consisted in the establishment of a president and council of fifteen, the former to be a member of the cabinet, and styled secretary of state for India. Interest at the rate of 10½ per cent. on the capital of the old company was charged on the revenue of India. All property possessed by the company in their corporate capacity was transferred to the crown, and the troops employed by it, to a great extent, entered her Majesty's service and became her Indian army. The East India House in Leadenhall Street was pulled down, and its library and museum passed into the hands of the crown.

In 1873 an Act was passed by which the dividends on East India stock ceased to be paid, the proprietors receiving the option of accepting certain government stock, funds, or securities by way of commutation, or of being paid off at the rate of £200 sterling for every £100 of East India stock. Thus the corporation was entirely dissolved, "John Company" (its old Indian nickname) disappeared, and there is now nothing save in history to denote the existence of the once mighty East India Company.

EAST SAXONS were the last tribe to arrive in the English conquest. They occupied Essex (East-Sexe), south of the East Angles, in the sixth century, with the old British Camulodunum (*dun*, or town, of *Camulus*, Mars), called by the Romans Col-chester (camp of the "colony"), as their chief town. A powerful part of them soon pushed into the interior and seized on the country round the midland Thames, and were hence called Middle Saxons or the Middle-Sexe. About 825 the great Egbert incorporated Essex with Wessex; and the land always managed to keep its English character, while the people immediately to the north of it were destined so soon to fall under Danish domination.

EAST'BOURNE, a thriving seaside resort and popular watering-place of England, in the county of Sussex, 14 miles E.S.E. of Lewis, and 66 miles from London by the South Coast Railway. It is most agreeably situated on the coast, about 3 miles west of Beachy Head, at the base of the eastern extremity of the Downs. It formerly consisted of three parts—the village of Eastbourne, about a mile inland, which derived its name from a bourne or spring that wells out of a chalk hill beneath the church, and has a Norman church with sedilia and an Easter sepulchre; South Bourne, somewhat back from the shore, and Seahouses, facing the beach. These distinctions are now practically obliterated by the new town which has sprung up, chiefly from the two latter parts. Eastbourne is now an unusually handsome town, with wide, well-paved, and tree-bordered roads and streets, some of which are lined with shops, many of them vying in extent and character with London west-end establishments. The rough and irregular beach has been transformed into a paved and terraced promenade. The drainage has been very carefully attended to, and a good supply of water obtained.

A new pier, about 1000 feet in length, was erected in 1870. The town contains several churches and dissenting chapels, workmen's hall and club-house, assembly rooms, friendly societies' hall, and two convalescent hospitals; the foundation stone of another hospital, in memory of the Princess Alice, was laid by the Princess Helena on the 15th July, 1882. The Eastbourne College, a spacious semi-Gothic building, was erected in 1871 by the liberality of the Duke of Devonshire. The marine parade and other promenades extend for 3 miles along the coast.

Near the Wish Tower, which is an old martello tower mounting one gun, and situated on a hill commanding a view of the picturesque inland scenery, is an extensive recreation ground 12 acres in extent, known as Devonshire Park, the land for which was given by the duke, and which contains a large pavilion where concerts are held and other amusements are provided.

The climate of Eastbourne is very moderate, the influence of the sea-air tending in winter to lessen depressions of temperature experienced in greater force inland. The same influence operates in summer to mitigate the heat by causing the air to be charged with more than the normal amount of moisture. A fall of snow is a comparatively unfrequent occurrence, and when it does occur the snow seldom lies long on the ground. Situated as it is on the chalk Eastbourne is naturally dry, chest diseases and rheumatism being practically unknown there. The bathing obtained on the beach is excellent, while inland there are extensive salt-water swimming baths for both ladies and gentlemen.

The surrounding scenery exhibits a succession of romantic and agreeable features. Beachy Head raises its lofty wall of chalk to the westward—its extreme height being 575 feet. On a point somewhat lower, but projecting further into the sea, stands the Bell Font lighthouse, erected in 1831. Here, too, is a cavern called Parson Darby's Hole, excavated as a refuge for the shipwrecked by a former vicar of East Dean. Off Beachy Head was fought the indecisive but not inglorious battle (30th June, 1690) between the English and Dutch fleet of fifty-six sail, under Lord Torrington, and the French of eighty-two, under Comte de Tourville. The coast is dotted with martello towers, and a circular redoubt of twelve guns commands the entire sweep of Pevensey Bay. The population of the town in 1881 was 22,184.

EASTER, a movable feast, held in commemoration of the resurrection; being the most important and most ancient in observance, it governs the whole of the other movable feasts throughout the year. As its name implies the Christian Easter took the place of the Saxon festival to the goddess of spring, *Eástre*, she who heralded the dawn (*eást*) of the new year, beginning then in March.

By the Act of Parliament 24 Geo. II. c. 23, Easter

Sunday is "the first Sunday after the *full moon* which happens upon or next after the 21st day of March; and if the full moon happens upon a Sunday, Easter Day is the Sunday after." The Act which makes this statement also prescribes rules, that is, copies the rules of the Gregorian calendar, and the tables constructed from them.

The disputes which agitated the Christians of the second century respecting the observance of Easter depended upon two questions: first, whether the feast was to be a version of the passover, to be kept on the fourteenth day of the moon, or an anniversary of the resurrection, to be kept on the first day of the week; secondly, in what manner the full moon was to be predicted. It seems tolerably clear that towards the end of the second century the Metonic cycle of nineteen years was frequently introduced into the reckoning.

The Nicene Council (A.D. 325) attempted to bring about a general usage in keeping Easter. All their interference in the matter, as far as can be collected from the earliest historians of the council, Socrates and Theodoret, is contained in one sentence of the synodical epistle, as follows:—"We also send you the good news concerning the unanimous consent of all in reference to the celebration of the most solemn feast of Easter, for this difference also has been made up by the assistance of your prayers; so that all the brethren in the East, who formerly celebrated this festival at the same time as the Jews, will in future conform to the Romans and to us, and to all who have of old observed our manner of celebrating Easter." The case is clear enough; there was a great schism between the Easterns and Westerns, and the council simply decreed that the former should adopt the usual practice of the latter. St. Ambrose, in the next generation, in a letter written A.D. 386, says that the council had got up the method of the cycle of nineteen years, which they had named *Enneadecaëteris*. That is, Ambrose was not astronomer enough to know that both the thing and the name had been current even in elementary works for hundreds of years before the council met.

Shortly after the Nicene Council there were disputes about the proper cycle for Easter. It is unnecessary here to note the various cycles which were proposed. It was not till the time of Pope Hilarius (A.D. 463) that the cycle of nineteen years obtained a permanent footing. This pontiff employed Victorinus of Aquitaine to correct the calendar, and Victorinus actually constructed a cycle of 532 years, or of twenty-eight Metonic cycles. When Dionysius Exiguus (A.D. 530) altered the mode of reckoning, and abandoned the Diocletian era in favour of what he supposed to be the year of the birth of Christ, he adjusted the mode of reckoning employed by Victorinus accordingly, and the cycle of the latter has ever since been called Dionysian. From his time till that of the Gregorian reformation the rule was strictly observed, no disapprobation producing anything but written arguments. So that the Nicene Council neither succeeded, nor intended to succeed, in doing more than destroying, among the great bulk of Christians, what was called the *quartadeciman* heresy, the opinion that Easter was to be kept on the fourteenth day of the moon. The settlement of the arithmetical or astronomical question is the work of Hilarius and Victorinus. See CALENDAR, where also is given a convenient table for finding Easter in any year during the present century.

EASTER EGGS. The use of these is the most widely-spread and general of all Easter observances, and was in the first instance derived from the heathen spring festival, when eggs were given as typifying the revivification of nature. Originally the eggs appear to have been taken on the morning of Easter to the priest, who blessed them, sprinkled them with oil, and incensed them; they were then carried home, and either partaken of at a special meal, or given to relations and friends. Among members of the Greek Church the custom retains its religious significance, and is observed with much ceremony. Elsewhere it has degenerated into an occasion for bestowing gifts on children and the interchange of tokens between young people.

EASTER ISLAND, a small volcanic island in the South Pacific, situated about 2000 miles from Chili. It is 11 miles long and 4 broad. Except the small uninhabited island of Sala y Gomez there is no land between it and South America, while it is 1800 miles from Pitcairn Island, the nearest of the South Sea group. Most curiously this small isolated island, inhabited by a few savages still using the most rudimentary stone tools, contains the remains of an extinct race whose stupendous buildings and statues bear witness to a considerably advanced state of civilization. At the south-west end are nearly 100 houses, built of stone, with walls 5 feet in thickness. The inside of the walls is painted in black, white, and red, with figures of animals and birds, and other designs. The houses are roofed in with overlapping slabs of stone. Near these wonderful ruins the rocks are carved into fantastic shapes or faces, most of the sculptures being now almost overgrown with bush and underwood. On nearly every promontory are erected huge stone platforms facing the sea, and presenting a front sometimes nearly 300 feet long and from 20 to 30 feet high. On these immense platforms are great pedestals of stone, on which once stood gigantic statues, which, however, are now all thrown down and partially mutilated, with the exception of those on the platform near the crater of Otouli, which are still erect. Some of these images were 37 feet high; but the average height was about 16 or 17 feet, other statues being much smaller. The heads of these sculptured images are flat, and were formerly capped by crowns of red tufa, a stone that is found only at a crater called Terano Hau, near which have been found a number of crowns ready for removal to the statues. At present the name of the builders and the reason of their choice of this spot is enveloped in mystery.

The Maison Brander of Tahiti in 1878 purchased the property of the missionaries on the island, who then left for the Gambier Archipelago, taking about 300 of the natives with them. A large grazing farm was thereupon established, and there are now about 10,000 sheep and 400 head of cattle on the island, the flocks increasing very rapidly, as there are two and sometimes three lambing seasons in the year. There are enormous numbers of poultry in a semi-wild state, but all owned by the natives; in fact a fleet could easily be supplied with fresh provisions, except vegetables; but as yams, sweet potatoes, bananas, and plantains grow readily, they also could be supplied in time. Water is the only scarce article. The natives now remaining are only 150 in number, and they are rather decreasing than increasing.

The inhabitants assert that they originally landed on the north side of Anakena, and came from the east in two canoes, provisioned with yams, taro, and sweet potatoes, the king (by name Hotometva, or the "Prolific Father") in one canoe, the queen in the other. On making the land they separated, passing round in opposite directions, and meeting again at Anakena, where they landed and settled on Mount Topaze, of which the native name is Hoto-iti. They there built the stone houses, the remains of which still exist, and made the statues with which the hill is covered; but the first statue was not made till some fifty years after they landed. They also say that the original name of the island was Te-pito-fenva, *i.e.* the land in the middle of the sea.

The extinct volcano of Te Rama Kao, on the south-west corner of the island, is well worthy of a visit. The bottom of the crater is not level, as was formerly thought; on the contrary there is no bottom at 50 fathoms in the centre, but there is a carpet of decayed vegetation spread over the water, on which one can cross from side to side.

EASTER OFFERINGS or **EASTER DUES** are small sums paid to the English parochial clergy by their parishioners as a compensation for personal tithes, or tithes for personal labour.

EAST'ERLINGS were merchants from the east (as shavelings were men who shaved, *i.e.* tonsured priests); and some Easterling merchants from the Hanse Towns being in London in the time of King John, who had debased the coinage till its value was no longer recognizable, the barons forced the king to engage these Easterlings to reform the coinage, as they had already become famous in such work. Camden has a passage upon this:—"In the time of king Richard I. monie coined in the east parts of Germany began to be of especiall request in England for the puritie thereof, and was called Easterling monie; and shortly after, some of that countrie skillfull in mint matters and in alldies were sent for into this realm to bring the coine into perfection, which since that time was called of them (*i.e.* in memory of them) Sterling, for Easterling." This is the origin of our "pound sterling," "sterling silver," &c., as expressing bullion or coin of the national standard of fineness.

EASTLAKE, SIR CHARLES LOCK (1795–1865), president of the Royal Academy from 1850 to 1865, and director of the National Gallery, though not a painter of the highest rank, exercised a great and on the whole a beneficial influence on painting in his day. He was a scholarly man, and wrote a great deal, doing perhaps more good in that way, and by directing the national purchases of pictures, than by direct example. His efforts to reform the style of furniture, for instance, were very successful. Several of his pictures are in the national collection—the best being "Christ Lamenting over Jerusalem." Sir Charles Eastlake's life was uniformly prosperous, and presents nothing worth recording. His style is very earnest and graceful, and he began the steady endeavour to truthfully search out nature's secrets, which has led, and is leading, to such excellent results. He was succeeded in the presidency of the Royal Academy by Sir Francis Grant, at whose death Sir Frederick Leighton was elected. Sir Charles Eastlake's principal work is "Materials for the History of Oil Painting" (London, 1847), a useful book. His widow, Lady Eastlake, his diligent admirer and student, has continued his work. Her "Five Great Painters" (two vols. 1883), written, she modestly says, through "the advantages enjoyed by her for long years at the side of the late Sir Charles L. Eastlake," is an excellent comparative account of Dürer, Da Vinci, Michael Angelo, Raphael, and Titian.

EASTON, an active trading and flourishing town of Pennsylvania in the United States, situated on the Delaware River immediately above its junction with the Lehigh, 54 miles N. of Philadelphia. Owing to its advantageous canal and railway connections it occupies a commanding trading position. One canal communicates with the great coal-field of the state, another along the Delaware unites it with Bristol, and a third with Jersey city. Easton has breweries, tanneries, carriage factories, and iron-foundries. Its chief institution is the Presbyterian Lafayette College, which was founded in 1831.

EAU-DE-COLOGNE (Fr., water of Cologne), an alcoholic liquid perfume, originally manufactured at Cologne, for which Dr. Ure gives the following recipe as a good substitute:—"Take alcohol one pint; of the oils of bergamot, orange-peel, and rosemary, one drachm each; bruised cardamom seeds, one drachm; orange-flower water, one pint; distil one pint from a water-bath." As to the veritable Jean Marie Farina who makes the real eau-de-Cologne there is a curious contest existing in Germany. It was carried on even in the Crystal Palace in 1851, where there were four Farinas all claiming to be the original. In one of the jury reports of that exhibition it was stated that "speculation is carried to so high a pitch in Cologne, that any child entitled to the surname of Farina is bargained for as soon as born, and christened Jean Marie; at times this event is even anticipated."—*Eau-de-Javelle* is a bleaching liquid composed of hypochlorite of lime, four parts; carbonate of potash, four parts; and water, forty parts, boiled and filtered.—*Eau-de-Luce* is a volatile preparation made thus:—Dissolve 10 or 12 grains of white soap in 4 oz. of rectified spirit of wine; strain the solution; then add a drachm of rectified oil of amber, and let the whole be filtered. Mix with the solution some strong ammonia.—*Eau-de-Rabel* consists of one part of sulphuric acid to three of rectified spirit of wine.

The quantity of perfumed spirits—principally eau-de-Cologne—annually imported into Great Britain is about 50,000 gallons, valued at £85,000. The customs duty is 16*s.* 6*d.* per gallon. Nearly the whole is imported from Holland and France.

EBENA'CEÆ, an order of plants belonging to GAMOPETALÆ. The flowers are regular, generally diœcious; the calyx is inferior, persistent, and often increasing in size as the fruit ripens; the corolla is hypogynous, the male flower has the stamens alternate with the lobes, or alternate and opposite, hypogynous, or partly epipetalous; the female flower has as many cells as carpels, each with two ovules, or each cell divided into two with one ovule in each pendulous from the inner angle, two to eight styles, and an embryo with a superior radicle. The species consist entirely of bushes or trees, some of which are of large size; their leaves are alternate, with no stipules, and generally leathery and shining. *Diospyros Ebenum* and some others yield the valuable wood called EBONY. Another species yields CALAMANDER WOOD. Timber for building purposes is obtained in New Caledonia from species of Maba and Diospyros. Black dyes are obtained from *Diospyros mollis* in Burma. The fruits are generally astringent and sometimes poisonous. In Madagascar a decoction of the leaves of *Maba buxifolia* is used in cases of gastritis. There are about 250 species. The headquarters of the order is India, and the majority of the species are confined to the tropical regions of both the eastern and western hemispheres. Two out of the five genera are peculiar to Africa, and one to Madagascar.

E'BIONITES, a sect of Christian Jews which existed in Palestine and other parts of the East in the first and second centuries of our era. Origen, Epiphanius, Eusebius, and other early fathers distinguish two sorts of Ebionites, namely, those who denied the divinity of Jesus Christ, asserting that he was the son of Joseph and Mary, though endowed with a prophetic gift; and those who maintained that he was born of a virgin, but denied his pre-existence as God. The word *Ebion*, plural *Ebionim*, simply means "poor," and probably included the idea of community of goods. In this sense Jesus taught Ebionism. The Galilean disciples of Jesus called themselves Ebionites, the "poor folk," and waited the coming of the "kingdom of the poor;" so also of the Judaizing Christians of the Batanea and of the Hauran, who boasted that they alone held pure the doctrines of Jesus, and that among them dwelt descendants of his family. By the development of dogmatic theology the "poor folk" were left behind, and came to be manifestly opposed to the doctrines of the church, which therefore pronounced them heretics, and Tertullian was good enough to invent a certain Ebion, whose heresy they followed (see Renan, c. xi.)

The Ebionites, with their gospel of poverty, were the precursors of St. Francis and the Friars. Their dogmatic tenets are only known through their avowed enemies, and, with that reserve, may be thus stated—

They believed in the return of Jesus, and expected that on his second coming he would restore Jerusalem, the city of God, and reign there as king over the whole world. Of the books of the New Testament the only one they received was the Gospel of St. Matthew, and they regarded

the Epistles of St. Paul with especial aversion, believing him to be a separatist and an apostate from the law. They all emphasized the doctrine of the unity of God and rigorously kept the Jewish law, though some of them taught that the obligation to obey the latter was only necessary for Jews and did not extend to Gentile believers. They disappear from history about the commencement of the fifth century. It is generally supposed that the Clementine Homilies [see CLEMENT, ST.] were written by an Ebionite.

EB'LIS, the Mohammedan counterpart of the Hebrew SATAN. In the second chapter ("The Cow") of the Koran God "said unto the angels, Worship Adam, and they all worshipped him except Eblis, who refused, and was puffed up with pride, and became of the number of unbelievers." Before his fall Eblis was called Azazel, and he as a "spirit of smokeless fire" thought it shame to reverence a creature of the dust. He became after his fall prince of the genis or fallen angels. Beckford's thrilling description of the hall of Eblis, in "Vathek," is one of the classical pieces of English literature.

EB'ONITE, a name given to one of the forms of india-rubber, the latter being mixed with sulphur and exposed to the combined action of heat and pressure, something in the same way as vulcanite or vulcanized india-rubber. Combs, paper-knives, and various small articles in imitation of jet are made of it, and some are as tough and strong as buffalo-horn, which they resemble in appearance.

EB'ONY is well known as a hard, black-coloured wood brought from the hot parts of the world (Heb. *eben*, stone, *i.e.* hard as a stone; the Greek name is *ebenos*, from which our word ebony is immediately derived). From its hardness, durability, susceptibility of a fine polish and colour, ebony, which has almost become another name for blackness, has always been in high estimation, and is much used for mosaic work, ornamental inlayings, pianoforte keys, some kinds of mathematical instruments, veneering, superior cabinet work, &c. The heart-wood of several trees yields this kind of wood, for the most part belonging to the genus Diospyros. All the species of Diospyros form large trees, with alternate, thick, and often coriaceous leaves. The species are found chiefly in the tropical parts both of Asia and America, as in the Malayan Archipelago and peninsula, and in almost every part of India.

Diospyros Ebenum, the true ebony, and that which is considered to be of the best quality, is a large tree, a native of India, Ceylon, and Malaya. The leaves are smooth, oblong; the buds are hairy; the male flowers subracemed, with sixteen anthers; and the female flowers solitary, with generally sixteen staminodes. Large quantities of the ebony of this species have been sometimes imported into Europe. *Diospyros Ebenaster* is also a tree of considerable magnitude, a native of Malaya, of which the leaves are coriaceous and smooth on both sides, and the buds smooth. *Diospyros melanoxylos* is the ebony tree of the Coromandel coast.

Several species of the genus bear fruit, which, though clammy and subastringent, is eaten by the natives of the countries where the trees are indigenous. *Diospyros Lotus* bears a sweet yellow fruit about the size of a cherry. *Diospyros virginiana* (the Persimmon tree) is indigenous in North America, especially in the middle and southern parts of the United States. The wood is useful, as it is hard, compact, and tough. The inner bark is useful in intermittent fevers. *Diospyros Paralea* is valuable in a similar way. The glutinous juice of *Diospyros Embryopteris* contains tannin, and is employed in South India for paying the seams of fishing boats. Birds are poisoned by the fruits of *Diospyros toxicaria*, and fish by *Diospyros multiflora*, *Ebenaster*, and *samoensis*.

EBORAC'UM or **EBURACUM**, the Roman military station on whose site York was afterwards built. Both the Roman emperors Severus and Constantius Chlorus died at Eboracum, and the latter there nominated his son Constantine as emperor when he lay dying. This prince afterwards became Constantine the Great. The Archbishop of York yet signs himself *Ebor*, as short for Eboracensis. See YORK.

EBULLI'TION. See BOILING OF LIQUIDS.

EBURO'NES, a German tribe, settled in ancient Belgium or northern Gaul, who inflicted some severe defeats on Cæsar's troops in his absence. Cæsar practically annihilated them.

ECBAT'ANA, the capital of ancient Media, was beautifully situated in the north of the country at the foot of Mount Orontes. It was used as a summer palace by the Persian kings when they succeeded to the Median heritage, and again after the Persian dynasty had fallen Ecbatana was the favourite cool summer residence of the Parthian kings. Its foundation was prehistoric, and Herodotus describes its seven walls, one within the other, each higher than the one outside it, as beyond reckoning ancient even in his day. The capitals of the pillars of the huge palace were of gold, and the pillars, wainscotings, &c., of silver. Alexander pursued Darius there after the battle of Arbela, and took rich booty; and Alexander's successors, the Seleucidæ, coined the precious pillars and walls into money. Antiochus alone took away 4000 talents' worth of silver (equal to £1,250,000 sterling). It was also at Ecbatana (or Achmetha), "in the province of the Medes," that Darius the king found the decree of his predecessor Cyrus permitting the rebuilding of Jerusalem (Ezra vi. 2). The rapacity of the Seleucidæ, followed by the vicissitudes of these regions, has destroyed every vestige of Ecbatana; two sites seem to answer equally well to the ancient descriptions.

It will be remembered that the picturesque book of Judith (Apocryphal Scriptures) begins thus: "In the twelfth year of the reign of Nabuchodonosor, who reigned in Nineve the great city; in the days of Arphaxad, which reigned over the Medes in *Ecbatane*," and proceeds to describe the wonderful old city previously to recounting the overthrow of Arphaxad by Nebuchadnezzar, and the subsequent tyranny of the latter's lieutenant Holofernes when he had come into Judea to punish the Jews for not obeying the war summons of the great king.

ECCEN'TRIC is the name given to a wheel which revolves round a shaft which does not pass through its axle. As a result an arm ending in a collar which surrounds the eccentric wheel or disc will be pushed to and fro, the "throw" of the eccentric being twice the distance between its own centre and the centre of the shaft. The arm thus thrown to and fro is made to shut and open alternately the slide valve of the engine, and so keep out or admit the steam, as the case may be, to the cylinder. This is the chief use of eccentrics, but there are many others.

ECCENTRI'CITY OF ORBIT (especially the eccentricity of the earth's orbit) is a term often used in discussing the motions of the earth and the other planets. It means in general language the distance between the centre of an ellipse (the intersection of the major and minor axes) and either focus of the ellipse. But astronomers always use the term to signify the ratio between the above distance and half the major axis of the ellipse, or what is called the "mean distance." Thus if the eccentricity of an elliptical orbit be ·01, it is meant that the centre of the ellipse is at the distance of 1-100th part of the half-major axis (or the 1-200th part of the major axis) from either of the foci of the ellipse. See also ELLIPTICITY.

EC'CLESHALL, a market-town of England, in the county of and 7 miles north-west from Stafford, and 141½ miles from London—being 2½ miles from the Norton Bridge station of the North-western Railway. The town is situated on a gently rising ground near the south bank of the river Sow, and consists of well and regularly built houses. The church is a large ancient building, where

Queen Margaret obtained sanctuary after the defeat of the Lancastrian forces at Blore Heath. It was thoroughly restored, and a new east window inserted in 1868, as a memorial to Bishop Lonsdale, who was buried in the church. Eccleshall also contains some dissenting places of worship, assembly rooms, and a new market-hall and corn exchange. The town has no manufactures, but a pretty good retail general trade. The population in 1881 was 4075.

ECCLE'SIA (Greek, an assembly of those who are summoned, *ecclétoi*) was more especially the name of the general assembly of the citizens of Athens held in the Pnyx. When an assembly was called, slaves went into the market-place and other chief places with a rope daubed with vermilion, driving the people before them, so that they who disobeyed the summons were found to be marked with vermilion and fined. At the same time a slight inducement was held out to attend in the shape of a small fee.

The assemblies of the early church being called by the ordinary Greek term *ecclesia* this term took quickly a special signification, and indeed soon came to signify what we now call "church."

ECCLESIAS'TES (Heb. *Koheleth*). The title of this book in the Authorized Version, "Ecclesiastes or the Preacher," is but an imperfect rendering of the Hebrew name, which is properly a feminine participle, and means "calling together an assembly," and which seems to be adopted by the writer from his design to gather together his countrymen into communion with God notwithstanding the difficulties found in nature and human life. In the Jewish division of the books of the Old Testament it ranks as one of the five Megilloth or Rolls, though it appears from the Talmud that its canonicity had been disputed at one period. It has always been received as canonical by the Christian Church.

The book purports to be written by Solomon, and that it was his work was the universally accepted belief both of Jews and Christians up to a comparatively recent period. Modern scholars, however, are almost unanimous in their rejection of this view, and the book is generally regarded as one of the latest in date of the Old Testament. The chief reasons for the rejection of the theory that regards Solomon as its author are—1, that the language in which it is written is post-exilian, so much so that Ewald declares "the Hebrew is so strongly penetrated with Aramean that not only oft-recurring words are entirely Aramean, but the foreign influence is infused into the finest veins of the language;" 2, the internal evidence is altogether against this theory, seeing that the writer speaks of the kingship of Solomon as in the *past*, refers to the evils of government in a tone of bitterness hardly likely to come from a ruler who had caused them, and alludes to circumstances that did not occur under the reign of Solomon, but which did occur when the country was under Persian rule; 3, that the tone of thought that pervades the book did not arise until a period much later than that of Solomon; 4, that no mention is made of this book in the enumeration of Solomon's writings given 1 Kings iv. 32.

Concerning the scope and design of the book there have been the widest differences of opinion among commentators, and many wild and extravagant theories of interpretation have been propounded. Perhaps the most reasonable theory, and one which obtains the widest acceptance, is that which regards the book as a deeply earnest attempt to solve the mystery of life, and to indicate the course of conduct best adapted to attain true felicity. In pursuit of his subject the author successively examines various schemes for obtaining happiness, looks abroad into the course of nature, into political and social as well as individual life, and after many failures is led at last to the conclusion that it is only when life is spent in the service of God and with the hope of a future, in which the mysteries of providence at present insoluble shall be cleared up, that it is worth living, but that with these there are safety and peace. In his researches the writer passes through many of the stages of thought and feeling which find expression in the agnosticism and pessimism of the present day, though unhappily most of the advocates of these systems fail to arrive at his final conclusion.

ECCLESIASTICAL COMMISSIONERS were a body appointed in 1835 to examine into the temporal affairs of the Church of England. Their instructions were "to consider the state of the several dioceses of England and Wales, with reference to the amount of their revenues, and the more equal distribution of episcopal duties; also the state of the several collegiate and cathedral churches, with a view to the suggestion of such measures as might render them more conducive to the efficiency of the Established Church; and to devise the best mode of providing for the cure of souls, with special reference to the residence of the clergy on their respective benefices." By the 19 & 20 Vict. c. 55, the duties of the Church Building Commissioners were transferred to the Ecclesiastical Commissioners. The commission consists of all the bishops of England and Wales, the deans of Canterbury, St. Paul's, and Westminster, the two chief justices, the master of the rolls, the chief baron, and the judges of the Prerogative and Admiralty Courts; also nine lay members, seven appointed by the crown and two by the Archbishop of Canterbury. In addition to these, the queen may appoint two and the Archbishop of Canterbury one (lay members of the Church of England), by the title of Church Estates Commissioners. The powers of the commissioners enable them, when it is considered needful, to divide or unite existing parishes, and to create new districts. To provide a fund to carry out such schemes as should appear desirable, the seven best-endowed sees were laid under a contribution amounting to £22,800 annually. In addition to this income several canonries in the various cathedrals were abolished and other ecclesiastical preferments extinguished, and the emoluments of the whole vested in the commissioners. The revenue derived from these and sundry sources, together with private benefactions, forms a "common fund," the professed object of which is the augmentation and endowment of benefices having cure of souls. Among the results of the commissioners' proceedings during the first forty years of their existence, are the creation and endowment of two new bishoprics, the augmentation of a considerable number of small livings, and the constitution of numerous new parishes and district chapelries. They have raised to £300 a year the incomes of all livings in public patronage with populations of 4000 and upwards, and of all livings in private patronage with like populations, where one-half the required augmentations have been provided from non-ecclesiastical sources. Grants have been made which, together with local resources, have raised incomes of parishes with 300, 400, and 500 persons, to £200, £250, and £300 respectively. A considerable number of new districts with large populations have been endowed with incomes of £200 a year.

The value in fee of the estates now dealt with by the commissioners is £11,500,000, and the income of the common fund amounts to about £800,000 annually.

On the disestablishment of the Irish Church in 1869 commissioners were appointed to receive the revenues formerly belonging to it, and to see that the provisions of the Act were properly carried out. See IRELAND.

ECCLESIASTICAL COMMITTEE. See following article.

ECCLESIASTICAL COURTS. In Anglo-Saxon times justice was administered in the county courts under the auspices of the bishop and ealdorman of each shire. There were, however, two subjects of jurisdiction which would naturally fall under the peculiar cognizance of the

bishop—those of matrimony and testamentary disposition: the former as a sacrament, the latter because the clergy alone could read and write, and were qualified therefore to register, take care of, and interpret wills.

When, after the Conquest, the spiritual or ecclesiastical jurisdiction of the bishops was separated from that of the secular courts by William I. as a thank-offering to the pope, they carried with them these two subjects of jurisdiction.

An attempt by Henry I. to regain possession of the legal authority his father had so unwisely given away failed utterly; and Stephen made use of the priests in the Civil War, granting them all the power they asked. Consequently when Henry II. again sought to undo the mischief it had taken too firm root, and although the Constitutions of Clarendon restored some order to the relations between clerical and lay courts, yet the long resistance, and especially the murder of A'Becket, brought triumph to the church in the long run. In 1275 the claims of the clergy to be tried only in their own courts were once and for all annulled by Edward I., following with a stronger hand in the lines of Henry II. The great question of the clergy being amenable to the law of the land being thus settled, the ecclesiastical courts went on (with frequent complaint) until 1534, when in common with the whole church they were reformed. Their shape then became as follows:—

The Commission of Delegates, exercising the functions of a supreme court of ecclesiastical appeal, in order to obviate the necessity and take away the power of the appeal to Rome. This lasted till 1832, when it was superseded by the judicial committee of the Privy Council.

The Prerogative Courts, for will cases, was merged in the Court of Probate in 1857.

The Court of Arches (held at first in St. Mary of the Arches, St. Mary-le-Bow, whence its name) is the general court of ecclesiastical appeal. Its president, the Dean of Arches, is the deputy of the Archbishop of Canterbury. By "letters of request" the bishops send their own cases for hearing before the Court of Arches: in this case it loses its dignity of a court of appeal. See Arches, Court of.

The Bishop's Courts, or consistory courts, to which an appeal lies from the *Archdeacon's Court*, the ecclesiastical "court of first instance."

These courts now deal with clerical matters of the Church of England only—points of discipline or theology; with the proper administration of justice they have happily no longer any connection. They were regulated by statutes in 1689 (after the Revolution), in 1813, 1829, 1833, 1840, and 1857, when the Courts of Probate and Divorce were instituted, as mentioned below.

The ecclesiastical courts constituted a regular judicial system, each with a local registry, with learned persons as officials qualified to register wills and interpret their terms, or to declare the next-of-kin and course of administration in cases of intestacy. In course of time, however, no doubt on account of the infirmity of the ecclesiastical courts in the absence of coercive jurisdiction, which they could not exercise directly, but only in a circuitous way by certifying disobedience of their sentence to the Court of Chancery, from which a process was issued, this latter court came to assume and exercise jurisdiction in matters of contract and of trust, the more so as the chancellors were for many ages ecclesiastics. Under the feudal system the power of devising lands did not generally exist, and thus it happened that the jurisdiction of the ecclesiastical courts as to the validity of wills was only exercised in those of personalty. Indeed, as it was always a cardinal maxim of common law that the title to land could only be decided in the king's courts, the ecclesiastical courts never acquired jurisdiction to determine as to wills of land; and hence, when under the Statute of Wills, in the reign of Henry VIII., the power of devising lands was given generally, there arose this anomaly, which continued to our own time, that while wills devising realty and personalty were registered in the ecclesiastical courts, and their validity determined there as to wills of personalty, their validity as wills of realty was only determinable in the courts of common law. But as to wills of personalty, the ecclesiastical courts decided as to their validity, as well as to the distribution of the assets in case of intestacy, while the Court of Chancery decided as to matters of trust.

Thus there were great anomalies and difficulties of jurisdiction, added to which the ecclesiastical courts held marriage indissoluble, and the other courts had no jurisdiction in such matters. In these circumstances, and especially as the appeal from the ecclesiastical courts was to the Privy Council, or rather the commission of delegates—a tribunal of uncertain constitution—in 1831 a royal commission recommended that a superior court should be constituted with jurisdiction in matters of testament and matrimony. It was not, however, until 1857 that the recommendation was properly carried out in the Acts constituting the Courts of Probate and Divorce, giving them all the jurisdiction of the ecclesiastical courts in those matters, and also conferring jurisdiction for the dissolution of marriage as well as for judicial separation. Two courts were constituted, though from motives of economy only one judge was created for both.

Under the Judicature Act of 1875 the judges of the Courts of Probate and Divorce and the judge of the Court of Admiralty constitute one division; but any other judge is capable of transfer thereto, and all the judges are competent to exercise all the jurisdictions of all the superior courts.

ECCLESIASTICAL DIVISIONS. The division of the country into dioceses, archdeaconries, and deaneries took place in very early times. Most of the present bishoprics were founded in the Saxon period, when they were conterminous with the kingdoms or subkingdoms. Thus by help of the diocese of Lichfield the kingdom of Mercia has been traced out quite clearly. Originally there were three archbishoprics—of Canterbury, York, and Caerleon in Wales; the latter was suppressed by Henry I. and the territory annexed to the see of Canterbury. Subdivisions of the dioceses were soon found to be necessary. Henry VIII., with a portion of the proceeds of the confiscated monasteries, founded several new bishoprics; and the same Act which created the next additions to the episcopate—6 & 7 Will. IV. c. 77—gave the Ecclesiastical Commissioners power to alter the limits of all dioceses, and to effect a transference of parishes from one diocese to another, with a view to the more convenient distribution of territory and population.

Archdeacons anciently were only members of chapters without territorial jurisdiction. The assignment of specific limits for archdeaconries took place soon after the Conquest.

Rural deaneries were recognized ecclesiastical divisions of a diocese in Saxon times. They seem to have been designed to correspond with hundreds in the political division of the country, as archdeaconries were possibly intended to correspond with counties.

The ancient primary division of the land for spiritual purposes was exclusively into parishes; but in course of time, as population increased and additional churches were erected, certain portions of particular parishes came to be assigned by custom to the newly-established places of worship; and these at length, under the name of "chapelries," acquired boundaries as definite and generally recognized as those of the parent parish.

The country is ecclesiastically divided into two provinces, thirty dioceses (including Sodor and Man), eighty-two archdeaconries, and 613 rural deaneries; altogether about 3000 ecclesiastical districts have been constituted, and the total number of cures or benefices in the country is estimated at about 13,500.

ECCLESIASTICAL MODES, in music. See Modes, Ecclesiastical.

ECCLESIAS'TICUS, the Latin title of an apocryphal book of the Old Testament, which is called in the Septuagint "The Wisdom of Jesus, the Son of Sirach." The date of the book is uncertain, and is variously estimated by scholars as late as 180 B.C., and as early as a century sooner. It is of Palestinian origin, and was originally composed in the Hebrew or perhaps Aramean dialect. The original text was extant in the time of Jerome, who says he had seen it, but the only portions of this that now remain are a few fragments embedded in the Talmud and some of the rabbinical writings. The translation into Greek was executed by the grandson of the original author in Egypt, but scarcely anything is known concerning either person. The design of the book appears to be to commend wisdom, with the religious and moral duties inculcated by it, as the true path of human happiness, and the style of the writer is of a very noble and elevated character. Several of the fathers refer to this book as "Scripture," while others mark it as a book of the second rank—*i.e.* uninspired, though reckoned profitable for study. It was included in the canon by Augustine, and since the Council of Trent it has formed one of the canonical books of the Roman Catholic Church. The Jews never included it in their canon, and it is regarded as apocryphal by all the reformed churches.

ÉCHELON (Fr. *échelle*, a ladder), in military tactics, the position of a regiment or army in the form of steps, or with one division more advanced than another. In this formation the successive divisions are placed parallel to one another, but no two on the same alignments, each division having its front clear of that in advance, so that by marching directly forward it can form in line with it. This movement is frequently used for changes of position, or for taking up a new front, in the presence of an enemy, since by each portion thus echelonned suitably wheeling the force can with ease be made to face wherever required, a thing almost impracticable when the force is moving as a whole.

ECHIDNA or **PORCUPINE ANT-EATER** (*Echidna hystrix*) is the best known species of the family Echidnidæ, one of the two families into which the MONOTREMATA, the lowest mammalian order, is divided. In the genus Echidna the following characters are presented:—Muzzle elongated, slender, terminated by a small mouth, furnished with an extensible vermiform tongue similar to that of the true anteaters. No teeth, but the palate furnished with horny papillæ; feet short, very robust, and formed for digging, each armed with five strong claws; hind feet in the male furnished with a horny spur, connected with a secreting gland, and probably of a sexual character; tail very short; body protected above with stout spines intermixed with hair; eyes small and black.

The Echidna is about the size of a hedgehog, and not unlike that animal in general appearance, except that the dorsal spines are thicker and longer, the limbs far more robust, and the snout elongated and beak-like. This animal is formed for burrowing, and excavates the ground with great facility. It appears to be nocturnal in its habits, and like the hedgehog is capable of rolling itself up, so as to present a panoply of spines against its enemies. Its food consists of ants and probably of other small insects, which it captures, as do the ant-eaters, by means of its long slender protractile tongue. A living specimen of the Echidna was exhibited in the gardens of the Zoological Society. It was dull and sluggish, reposing half curled up during the greater part of the day. At times, however, it roused from its state of apathy and explored the cage, thrusting its snout through the bars in the hopes of finding some outlet of escape. It fed on bread and milk, but refused meal-worms. When irritated it curled itself up, and assumed the same position during sleep. It never attempted to use its spurs on the defensive. Its mode of taking its food was by a rapid protrusion and retraction of its long tongue.

The Porcupine Echidna is found in rocky and mountainous districts in New South Wales and other parts of Australia. Another species, *Echidna setosa*, differing principally in the length of the fur and the shortness of the spines, inhabits Tasmania. Another, *Echidna lawesii*, has been lately discovered in Southern New Guinea. In the north of New Guinea, in 1877, a new species was discovered by M. Bruijn, which presented differences considered by some of generic value. This Echidna (*Acanthoglossus bruijnii*) has the snout very much elongated and curved downwards. Nails are present only on the three middle digits of the feet. The tongue is armed with spines. In the number of the vertebræ this species differs from the genus Echidna, having seventeen dorsal and four lumbar vertebræ instead of sixteen and three. It is also considerably larger.

The generic name Tachyglossus is sometimes, but without sufficient reason, substituted for Cuvier's name Echidna.

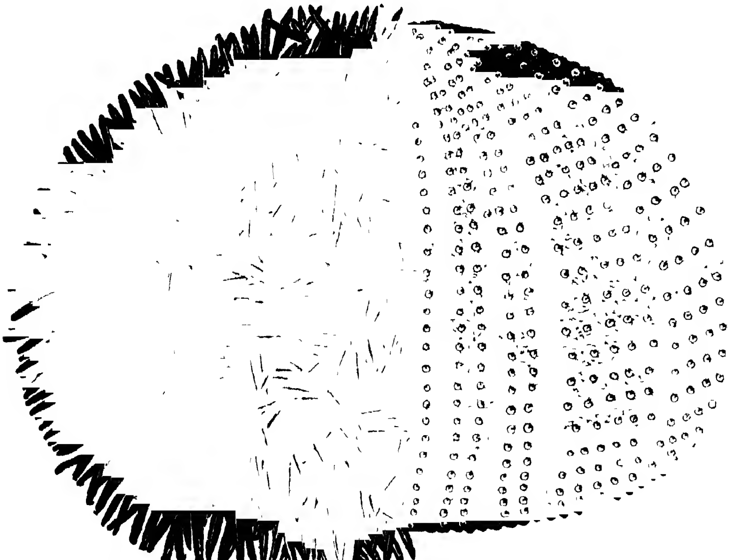
ECHINOCAC'TUS, a genus of plants belonging to the order Cacteæ, with the stem of an ovate or spheroidal form, the sides being divided into many ribs, upon whose projecting angles are stationed at short intervals little spiny stars, which are the rudiments of leaves, and from whose centre the flowers appear. The latter consist of numerous sepals collected into a tube, an equally large number of petals, numerous stamens, and a filiform style divided into many lobes at the point. The species are very remarkable for the singular forms of their stems, and for the curious manner in which their spines are arranged. They are often moreover conspicuous for the beauty of their large flowers. Most of the species are natives of Mexico and the West Indies; some are found in Brazil. The most remarkable species is *Echinocactus Visnaga*, a native of San Luis Potosi in Mexico. The spines of this species are used by the inhabitants as toothpicks, hence the specific name, Visnaga, which means a toothpick. On a comparatively small plant in Kew Gardens it was estimated that there were as many as 17,600 spines, and on a larger one not less than 51,000. In 1846 a plant of this species was sent to Kew which was 9½ feet in circumference and weighed 1 ton, but it had been injured on its passage, and did not long survive.

ECHINODER'MATA (Gr. *echinos*, hedgehog; *derma*, skin) is a subkingdom of the animal world, containing the sea-lilies, feather-stars, starfishes, sea-urchins, and sea-cucumbers. The members of this group are exclusively marine, either free-swimming or fixed by stalks. In the adult the various organs of the body are arranged as radii of a common centre, in which the mouth is placed. In some forms this radial symmetry is not very well marked. The larvæ as a rule exhibit more or less distinctly a bilateral symmetry. The Echinodermata differ from the CŒLENTERATA in having the alimentary canal distinct from the body cavity, and in having besides a distinct anal aperture. The skin is hardened by secreting carbonate of lime from the sea-water. In some cases a skeleton of great complexity is built up composed of interlocking calcareous plates; in others the skin is tough and leathery, with small scattered plates. The skeleton or "test" is in many cases furnished with movable spines. The Echinodermata have a remarkable system of tubes, the *ambulacral* system, homologous with the water-vascular system of VERMES, but serving the purposes both of respiration and locomotion. It consists of a ring round the commencement of the alimentary canal, from which proceed a number of radiating canals giving off lateral branches which enter the tube-feet (*ambulacral feet*), which are contractile processes of the body-wall, and in the free Echinoderms are organs of locomotion. This water-

vascular system communicates with the exterior by means of a tube starting from the ring. The nervous system consists of a ring surrounding the mouth, and giving off radiating branches. The sexes are generally distinct. The development from the egg is somewhat complicated. The larva or "pseudo-embryo" is free-swimming, ovoid, and provided with cilia, in some cases being provided with a calcareous skeleton, and being then known as a "Pluteus." After a time the cilia become restricted to one or more bilaterally symmetrical bands. An alimentary canal with a mouth and anus is present. The true echinoderm is developed like a bud inside this larval body, which is either absorbed or cast off (in which latter case it sometimes maintains for a short period an independent vitality), and the organs of the adult are developed afresh, and not from the organs of the larva. This mode of development is called metagenesis.

There are four classes. The first of these, CRINOIDEA, has the body attached by a stalk. The ECHINOIDEA are remarkable for the complexity of their test. STELLERIDA, containing the starfishes, brittle-stars, and sand-stars, has, as the common names show, a star-like body. HOLOTHUROIDEA, containing the sea-cucumbers, departs widely from the radiate type, having a cylindrical worm-like body.

ECHINOI'DEA is a class of the subkingdom ECHINODERMATA, of which the common sea-urchins and heart-urchins are familiar examples. The body is oval, round or heart-shaped, and is covered with a hard shell or test, composed of numerous interlocking plates, and thickly covered with spines, which fall off after death. In the annexed woodcut of an echinus the spines have been



Echinus.

removed from half the body, and the plates are shown bearing on their surface numerous tubercles on which the spines are articulated. The plates are arranged in definite areas (see Plate I., fig. 5, A and B), there being five areas in the test, composed of double rows (*b*) of small pentagonal plates, covered with few and small tubercles, but pierced near their edges with small pores or holes for the emission of the tube-feet. Alternating with these five ambulacral areas are five broader areas (*inter-ambulacral*) in which the plates (B *a*) are thickly beset with tubercles. The tube-feet are provided with terminal suckers, and, with the spines (C), are the organs of locomotion. All the areas converge towards the summit of the test, where, in the typical sea-urchins, the anal aperture (fig. 5, D, *a*) is situated. Surrounding this lie the five genital plates (*b*), perforated by the genital apertures. One of these plates is larger than the rest, and is pierced by a number of small pores, by which the water-vascular system communicates with the exterior. This plate (*c*) is called the *madreporite*. Wedged in between the genital plates, and situated at the apex of the ambulacral areas, are five smaller ocular plates (see figs. 6 and 7), each with a pore for an eye-spot. Some of the spines are curiously modified into *pedicellariæ*. These are scattered over the test, and consist of a long flexible stalk bearing at the summit two or three pincers or claws, which snap together and form a forceps. They are used to remove dirt from the shell, and perhaps also as weapons of defence. The mouth is situated at the base of the test, and is armed with five powerful jaws or teeth (figs. 9, 12), working in hard wedge-shaped sockets; the whole apparatus is known as "Aristotle's lantern." The alimentary canal is long and convoluted. The water-vascular system subserves both respiration and locomotion. It is composed of a ring round the commencement of the alimentary canal, from which proceed a number of radiating canals giving off cæcal appendages, known as Polian vesicles, and lateral branches which enter the tube-feet. From the *madreporite* runs the madreporic or sand canal, nearly vertically through the axis of the body to the ring round the œsophagus. There is also a blood-vascular system, the principal vessels of which are two trunks, one on the dorsal and the other on the ventral side of the alimentary canal. The sexes are distinct. The larval pseudo-embryo, or *pluteus*, has an internal skeleton of calcareous rods.

The Echinoidea are divided into three orders. The first, Palæchinoidea or Tessellata, is at once distinguished by having from three to six rows of plates in each interambulacral area. This small order is extinct, being confined to Palæozoic formations. The next two orders have two rows of ambulacral plates alternating with two rows of interambulacral. The first order, Endocyclica (Plate I.), contains the "regular" echinoids. In this order the mouth and anus are always central and opposite one another, and the powerful masticatory apparatus is always present. The test is circular or oval. The family Echinidæ (Plate I., figs. 5, 6, 7) contains the common sea-urchins or sea-eggs, some of which are common on our coasts. The families Diadematidæ (figs. 1, 2) and Cideridæ (fig. 3) have the tubercles perforated, and through the hole a small muscle passes and is attached to the spine. The family Echinometridæ (fig. 4) has an oval or elliptical test. The "irregular" echinoids (Plate II.) compose the order Exocyclica. In these the test has an oblong, pentagonal, disc-like or heart-like shape. The anus is not placed in a central position at the summit of the test. The masticatory apparatus is often absent. In some families the ambulacral areas are *petaloid*, that is, they do not run right round the test from pole to pole, but

form a rosette on the upper surface of the test (Plate II., figs. 21-23). The two families Clypeastridæ (figs. 8, 9) and Mellitidæ (figs. 10-12) have petaloid ambulacral areas, and the jaws (figs. 9, 12) are present; in Cassidulidæ (figs. 13-17) the jaws are absent. The family Galeritidæ, represented by *Galerites albogalerus* (figs. 18, 19), from the chalk, has non-petaloid ambulacral areas, the mouth central, and the anus situated on the margin of the under surface. The Spatangidæ (figs. 20-24) form a numerous family; they are found on British coasts, and known as "heart-urchins." The ambulacral areas are petaloid, the jaws are absent, and the mouth is not central.

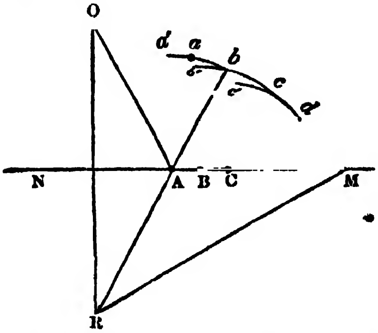
The animals belonging to this order are carnivorous, living chiefly upon seaweed, small molluscs, and crustacea. The jawless species extract nutritive matter from earth and sand. The recent species are numerous, and are found in most parts of the world; while the fossil remains of their shells or external cases are abundant in many of the formations, but especially in the chalk. Many of the Endocyclica hollow out with their teeth nests in rocks; the heart-urchins, on the other hand, bury themselves in sand or mud. All are gregarious in their habits. Sea-urchins have long been used as food. The ovaries of *Echinus esculentus*, found in the Mediterranean, are still considered a delicacy.

ECHI'TES, a genus of twining plants inhabiting tropical countries and belonging to the order APOCYNACEÆ. They have handsome salver-shaped yellow or white corollas, with included stamens, and are moreover remarkable for the singular fruit, which consists of two divaricating, woody, pod-like follicles containing a large number of silky seeds. They are dangerous lactescent plants. The name is derived from the Greek *echis*, a viper, in allusion to the twining shoots. The species are readily multiplied by cuttings under a glass, and grow well in a mixture of loam and peat.

ECH'IUM, a genus of plants belonging to the order BORAGINEÆ. The species are rough, shrubby, or herbaceous plants, with lanceolate or oblong-lanceolate leaves, and blue or white flowers. *Echium vulgare* (viper's bugloss) is a native of dry places in Great Britain and throughout Europe. It is a remarkably handsome plant. The flowers are at first reddish and afterwards become blue. About fifty species of this genus have been described; they inhabit Europe, West Asia, North Africa, the Canary Islands, and the Azores. All the species are worthy of cultivation, and the European species are among the handsomest of the indigenous plants of Europe. The shrubby species are all greenhouse plants, and will grow in a mixture of sand, loam, and peat; and cuttings will strike under a hand-glass in this mixture. They may be also propagated by layering and by seeds, which sometimes come to perfection in this country.

The corolla is somewhat bell-shaped, the throat naked, the lobes generally unequal; the stamens are unequal; the style filiform, shortly bifid; the fruit consists of four erect rough nucules, affixed to a hypogynous disc by a flat triangular base.

ECHO. When sonorous undulations are propagated from any origin through the elastic medium of the air in alternate shells of compression and rarefaction (concentric to the source of sound, as the coats of an onion to its core), this spherical wave conveys the sound through the circumjacent space, and at the ordinary atmospheric pressure and temperature moves from its origin and centre in all directions with a velocity of about 1125 feet in a second. Now, suppose the point O to be the origin of a sound which in its progress encounters a plane obstacle, NM; if this plane be sufficiently extended, a point, M, may be easily found which the sound will have just reached at the end of a given time. The waves which have previously reached the nearer points, A, B, C, being precluded from advancing, are there reflected; that is, new spherical undulations, $a'ab$, $b'bc$, $c'cd$, are generated from A B C, as centres, and it is easily seen that all these spherical surfaces, originating from A up to M and existing simultaneously, may be exactly enveloped by a single portion of a spherical surface of which the centre is placed in a position R, corresponding to O in respect to its distance from N M,



but at the opposite side of the obstacle; this spherical surface, of which the radius is R M, is the true returning wave at that moment, and being impressed on the auditory organs, so as to be distinguished from the original sound, is called the echo.

When a sound originates at any point and is reflected by a plane obstacle, the reflected pulsation of air occupies a conic frustum, the vertex of the cone being beyond the plane in the direction of a line let fall from the point perpendicularly to the plane produced. In order that a person may hear the echo of his own sounds, it is therefore necessary that he should be before the plane in the direction of a line drawn perpendicular to it; and that a second person may hear the echo of the voice of another, the parties must be so situated that the angles of incidence and reflection made by lines drawn from them to the plane may be equal to one another.

Hence it follows that wherever a person is situated the echo of a single sound is heard after the original sound, for the two sides along which the reflected sound is transmitted are greater than the third side in which the direct sound is propagated, the velocities in both cases being alike.

However, the echo of a continued sound or note may be heard in the inverse order of time to that in which it was generated, provided the origin of the sound moves more rapidly towards the hearer than the rate at which sound travels. Thus a flash of lightning moving towards a person will produce a roll of thunder which, echoed by the clouds, will be heard as it were backwards, ending instead of beginning in its loudest roar; but if the direction of the flash be such that the points of its current are nearly equidistant from the auditor, an instantaneous and intensely loud clap will be substituted for a continued roll.

The murmuring sound produced by the discharge of great guns is the succession of echoes from the particles of vapour floating in the atmosphere, and when the discharge is effected under a dense cloud the echoes are stronger and better reflected, and a noise resembling a thunder-roll may then be heard. The "ping" of a bullet is attributed to its state of rapid onward rotatory movement through particles of vapour.

The distribution of sound in public edifices, so that the echoes may be most advantageously brought to strengthen the original sound, and (which is equally important in opera-houses, &c.) may be prevented from interfering with sound waves already generated, is a subject practically deserving of much attention.

When the reflecting surfaces, instead of being plane, are curved, as in caverns, grottoes, rocks, or ruined buildings,

the reflected sound will be most intense at the foci, or the points which would be most enlightened *by reflection* if a luminous body were substituted in the place of the original source of sound.

The number of possible repetitions of an echo between two reflecting surfaces is theoretically unlimited; practically, however, each repetition becomes weaker and weaker through the inertia of the air (if from no other cause), and the succession of echoes comes to an end. But whether weak or strong each repetition occurs at exactly the same distance in time, for gentle sounds travel with the same rapidity as loud ones. At the old palace of Simonetta, near Milan, which forms three sides of a quadrangle, is an echo which gives twenty clear repetitions, and Kircher says he has counted as many as forty repetitions on favourable occasions. Of these, it is perhaps superfluous to remark, the first alone is a true echo, the second is the echo reflected as if it were an original sound from the second surface behind the observer and parallel to the originally reflecting surface; this echo of an echo itself provokes an echo from the first surface, and so the impulse is tossed to and fro till, as said above, the impetus is exhausted by the resistance of the air, &c. In his essay on "Sound" originally contributed to the *Encyclopædia Metropolitana*, besides the above most remarkable instance, Sir John Herschel mentions the following:—The well at Carisbrook (known doubtless to many readers, with its picturesque "treadmill" worked by a patient ass), which though 210 feet deep echoes the fall of a pin upon the surface of the water; the echo at Gloucester Cathedral, where a whisper is reflected 75 feet across the nave; that at St. Paul's across the dome; that at St. Albans, the whole length of the nave, so that a watch ticking in the choir is heard at the west door, &c. He notes an echo at Woodstock Park which will repeat seventeen syllables in the daytime and as many as twenty at night, in the greater stillness, different atmospheric pressure, and above all the absence of variation of density due to heated currents, which night gives, all more favourable conditions to the experiment. This is perhaps the *longest* echo well authenticated. The well-known echo at Terni will only repeat a sentence of fifteen syllables. Sound travelling at about 1100 feet a second, and about five syllables being clearly pronounced in a second, each syllable in a clear echo demands 220 feet start of its successor; that is, the observer must be at least 110 feet from the echoing surface to complete the sounding of one syllable before the sound has travelled thither and been reflected to him as an echo. A two-syllable echo must have 220 feet distance between the observer and the echoing surface, and so on. Therefore the echo in Woodstock Park, to give seventeen syllables clearly, must be excited at the considerable distance of 1870 feet, or over 600 yards.

ECHO, in the Greek mythology, was the name of a nymph who was beloved by the god PAN. But Echo, catching sight one day of NARCISSUS in the woods, fell in love with his matchless beauty, while Narcissus, being as usual quite absorbed in the contemplation of his own loveliness, paid not the least attention to her sighs. Echo fell into a melancholy so low that she fell away literally to a shadow, and nought remained of her but her voice.

With this legend Ovid has combined what was evidently originally a separate myth. Echo, according to this, was employed by Zeus to distract Hera's attention from his own pursuits, which would have been very displeasing to his queen had she known them, by her incessant merry chatter. An accident, however, discovered at once the amours of Zeus and the artifice of Echo. The enraged goddess condemned the nymph to perpetual silence unless some one else spoke, and then to servile imitation of the closing syllables of the sentence uttered. In this state it was, says Ovid, unable to express her love, that she endured the agony of the neglect of Narcissus; every scornful taunt that he flung at her was faithfully rendered back, though her heart was breaking. It is one of the most poetic conceptions in all literature.

ECHO ORGAN, a device introduced in the rebuilding of church organs, by Father Smith, Renatus Harris, &c., after their destruction during the Puritan era. It consisted of a few stops of the organ shut in a box, by which a soft and distant effect was produced, as with the shut swell of modern instruments. It was the parent of the life and soul of expressive organ-playing, the modern swell organ, an invention exclusively due to England, and for a considerable time peculiar to this country. See ORGAN.

E'CIJA or **E'ZIJA** (the ancient *Astigis*), a town of Andalusia, Spain, in the province of Seville, stands on the Genil, a feeder of the Guadalquivir, in a fine plain, about 53 miles north-east from the city of Seville, and has 24,000 inhabitants. The town has many churches and convents, several hospitals and other public buildings, and a very fine promenade along the banks of the Genil (the ancient *Singulis*), which is adorned with fountains and statues. The territory is rich in corn and olives; there are also some manufactories of woollens, linens, and shoes. The neighbourhood is fertile, but from the excessive heat it has been called the "frying-pan of Andalusia." There is a fine bridge over the Genil. Several Roman and other remains are found here, and it is said to have been visited by the apostle Paul.

ECLEC'TIC SCHOOL (of painting). This school is due to the famous sixteenth-century academy of Bologna, which endeavoured to combine the glorious artistic qualities of the century before (those of Michael Angelo, Raphael, Titian, &c.) with the introduction of natural effects. The Caracci were at the head of this movement, Lodovico Caracci (1555–1619) being helped by his two cousins, Agostino (1557–1602) and the fine painter Annibale (1560–1609), who redeems the movement from whatever of false there was in it, and who, if he had not felt compelled to imitate the merits of other masters by mere manual dexterity, might have been undoubtedly one of the greatest artists. This mannered and set "classic" style (not natural, as with Michael Angelo and Raphael, but adopted and self-conscious) was so far abandoned by the greatest of Annibale's successors, Domenichino (1581–1641), that the world has been enriched by some of its very finest paintings. The "Communion of St. Jerome" is an honour to any school, and smacks little of the weakness of eclectic picking and choosing for effects. His contemporary Guido Reni (1575–1642) is the third great name among this afterglow of Italian painting. Of the opposite camp, the Naturalists, who openly scoffed at any manner modelled on the great masters, the chief glories were Caravaggio (1569–1609), and later on Salvator Rosa (1615–1673).

ECLEC'TICS, the name given to those philosophers who, without adopting any particular system or dogmatizing for themselves, professed to select from other philosophical systems whatever they conceived most conformable to truth, and fitted those detached parts together so as to form a new whole.

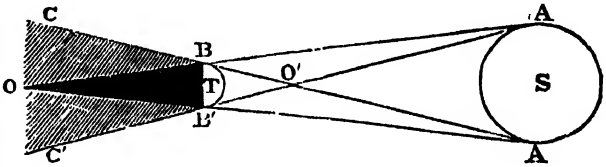
The founder of the ancient eclectic philosophical school was a certain Potamon of Alexandria, under Augustus and Tiberius, who seems to have split off from the Pyrrhonists or Sceptics.

Later, at the close of the second century, a school of Christian Eclectics arose in the church, who, like Potamon, took largely from Plato and the traditions of Pythagoras, and at the same time endeavoured to interweave their philosophical with their religious views. Such were Clement of Alexandria and Synesius of Cyrene, &c. Hence arose the Neo-Platonist school, of which Plotinus is the great chief, and which culminated in the person of the Roman emperor Julian (nicknamed the Apostate), thereafter to sink quickly into decline.

Modern eclecticism was founded by the brilliant French philosopher Victor Cousin. He began with warmly advocating the Scotch philosophy of Reid, Dugald Stewart, &c., but not long after preached certain portions of the Kantian system with equal vigour. After this doctrines from Proclus, the last and among the most interesting of the Neo-Platonists, were added; and the curious mass of heterogeneous doctrines finally received some of the Hegelian mist. It was the *reductio ad absurdum* of metaphysics and philosophy, and may be said, by its absurdity, to have crushed French philosophy. It paved the way for the logical and connected theories of Comte.

ECLIPSE. Among the varied phenomena of astronomy there are perhaps none which present greater popular interest than the occurrence of eclipses. In ancient days eclipses have often been the occasion of superstitious terror, but they have long since proved amenable to order, and the occurrence of an eclipse is now predicted in the almanacks with unfailing accuracy. It is certainly a striking and wonderful spectacle to behold the brilliant sun himself gradually obscured and completely obliterated in mid-day. During a total eclipse of the sun the stars have been seen to spring forth, and even flowers have been observed to close their petals; but we can now anticipate when such occurrences will happen and how long they will last, and we can even indicate the points on the earth where they will be seen. We can tell what eclipses of the sun happened 1000 years ago, and what eclipses will happen in 1000 years to come. We shall attempt to explain some of the general features of eclipses and the laws of their recurrence. An eclipse of the sun is caused by the moon coming between the earth and the sun. If the moon crosses the sun in such a manner that the centre of the two bodies come very close together, then the eclipse assumes one or other of two very remarkable forms. It will sometimes happen that the entire light of the sun will be intercepted, in which case the eclipse is total, and darkness reigns over the earth. This phenomenon—the most striking which astronomy presents—is, however, comparatively rare, nor when it does occur can it last long—the apparent diameter of the moon being little larger than that of the sun. The movement of the moon will in a few minutes enable the margin of the sun to be seen again; his beams can then revisit the earth, the total phase of the eclipse is at an end, though the partial eclipse continues much longer. Sometimes, even though the centre of the moon passes very close to the centre of the sun, the eclipse will not be total, but a ring of the sun's disc is visible around the dark centre formed by the body of the moon. In this case the eclipse is said to be annular. It may at first seem difficult to imagine how the same moon passing centrally across the same sun shall sometimes be large enough to hide the sun completely, while at other times the dark moon is, as it were, merely framed in the brilliant margin which surrounds the sun. It must be remembered that the path of the earth around the sun is somewhat eccentric, and that the sun's distance from the earth consequently fluctuates. The moon's orbit round the earth is likewise eccentric, and consequently the apparent sizes of the sun and the moon are continually changing. These changes are no doubt confined within narrow limits; they are not evident to ordinary observation, but it happens that the mean apparent size of the sun is almost identical with that of the moon, and consequently the apparent size of the moon is sometimes greater and sometimes less than that of the sun. If in the former case the moon passes centrally over the sun we have a total eclipse; if in the latter, the eclipse is annular.

It sometimes happens that the usually brilliant appearance of the *full moon* is modified by the appearance of a shadow with a circular edge which creeps slowly over the bright surface; the moon may escape with only a partial obscuration, but it may happen that the shadow completely envelops the moon, and the eclipse is then said to be total. The circumstances of the eclipse of the moon will be easily understood from the annexed figure, where S represents the sun and T the earth. The tangents A B and A′ B′ intersect at O, while the second pair of common tangents intersect at O′. In the course of its revolution around the earth the moon will sometimes enter the shaded region C B, B′ C′. At first the effect on the moon is a gradual diminution of its brilliancy, but when a portion of the moon's disc enters the darkly-shaded portion, B O B′, then that portion receives no direct light from the sun, and the moon is said to be partially eclipsed. Should the centre

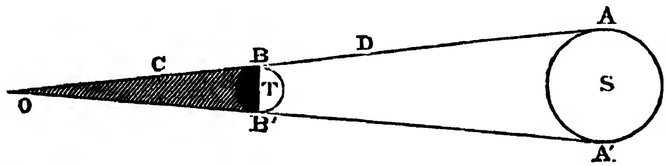


of the moon be plunged into B O B′, then the direct light is entirely cut off, and the result is a total eclipse. It is a very curious circumstance that even while the moon is totally plunged into the earth's shadow it still sometimes remains visible with a peculiar copper-coloured hue, sufficiently bright on some occasions to enable the markings on the moon's surface to be recognized. This is due to the effect of the atmosphere surrounding the earth in refracting the sun's light and bending the rays into the cone forming the shadow. The peculiar copper-coloured light can be also readily explained. The rays to which this illumination is due have passed through an enormous thickness of the terrestrial atmosphere, and the absorption of light by the atmosphere tends to render the light which has passed through it of a ruddy colour.

An eclipse of the moon does not occur at every revolution. The plane of the moon's orbit is inclined to the plane of the ecliptic, so that at full moon the line joining the earth and the sun generally passes either over the moon or under the moon, but when the full moon occurs near the time when the moon is passing through its node or the point of intersection of its orbit with the ecliptic, then an eclipse is the result. Let us suppose that the time of full moon happened to be exactly coincident with the passage of the moon through its node. The position of the node is then 180° from the sun. In a period of 6585 days, equal to eighteen years and ten or eleven days (according to whether the 29th of February has intervened four or five times during the interval), we find that nineteen complete revolutions of the sun will have taken place with respect to the moon's nodes. It therefore follows that in 6585 days after the date of the eclipse, the node of the moon's orbit will again be 180° distant from the sun. It happens that this period is very nearly identical with 223 lunations, so that in 6585 days after the moon has been full at the node the moon will again be full at the node. It is not, indeed, necessary for the moon to be exactly at the node for the occurrence of an eclipse. If the moon be near the node a more or less partial eclipse can still occur. The same circumstances will very nearly recur at an interval of 6585 days, and therefore we shall find in general that 6585 days after the occurrence of a lunar eclipse there will be another eclipse. If, therefore, we know all the lunar eclipses which have occurred in a period of 6585 days, we shall be able to predict future eclipses with a considerable degree of accuracy. For example, in the year 1867 a partial eclipse of the moon,

visible at Greenwich, occurred on 19th March. If we add to this date eighteen years and eleven days we obtain 30th March, 1885, and accordingly we find on this date another partial eclipse of the moon. So also the total eclipse of the sun on 28th–29th August, 1867, is followed at the same interval by another total solar eclipse, which occurs on 8th September, 1885. It should, however, be observed that the relations on which this law is founded are only approximately correct. It will not be quite invariably true that a partial eclipse is followed or preceded by a similar eclipse at an interval of 6585 days. For accurate predictions of the details of an eclipse, such as we find in the *Nautical Almanack*, very careful calculations are necessary.

It is a curious circumstance that while eclipses of the sun are in reality more frequent than eclipses of the moon, yet at any particular locality visible eclipses of the moon are more frequent. In the annexed figure is shown the sun and the earth and two common tangents intersect-



ing at O. An eclipse of the moon will occur when the moon enters the cone B O B′, while an eclipse of the sun will occur when the moon enters the broader and larger portion of the same cone which is contained between the earth and the sun. Owing to the greater width of the latter region, it will be obviously more usual for the moon to cross the cone between the moon and the sun than in the narrower part of the cone near its vertex; but this is merely saying that an eclipse of the moon is not so frequent an occurrence as an eclipse of the sun. The case is different when we think merely of a single locality on the earth. The diameter of the earth's shadow at the distance of the moon is considerably greater than the apparent diameter of the sun. It will therefore obviously be a more usual occurrence for the moon to enter the shadow of the earth than for the moon to come in front of the sun.

A solar eclipse will usually occur at an interval of 6585 days after another solar eclipse, but we cannot by this rule predict the recurrence of solar eclipses with the same convenience as the lunar eclipses. We cannot by this method tell whether the solar eclipse will be visible at a given place, nor can we tell what the magnitude of the eclipse can be. There is no doubt that the sun's eclipses can be predicted with all needful accuracy, but the calculations for this purpose are very laborious.

Eclipses either of the sun or moon can only occur at two periods of the year, being those when the sun is near one of the nodes of the moon's orbit. Each of these periods is about a month long, and we may call them the seasons of eclipses. For instance, the sun passed a node near the middle of May, 1882; May was therefore a season of eclipses, and actually there was a total eclipse of the sun on the 16th. There could then be no further eclipses until the sun approached the other node in November, when an annular eclipse of the sun occured on the 10th. The middle of the eclipse seasons for many succeeding years can be found by starting from the 13th of March and 15th of September, 1885, and subtracting 19⅝ days for each subsequent year.

ECLIP′TIC. The word ecliptic in astronomy means primarily the *plane* in which the centre of the earth performs its actual orbit around the sun, but it is also applied in a somewhat secondary and derivative sense to the *great circle* in which the sun appears to perform its annual circuit round the heavens. Nor is it unreasonable that the same word should be used for both these purposes. The apparent orbit of the sun around the earth lies, of course, in the same plane as the real orbit of the earth around the sun. The plane of the ecliptic cuts the celestial sphere in that great circle in which the sun appears to move; hence it is that the great circle and the plane are either of them spoken of as the ecliptic. It would be better, perhaps, to confine the word *ecliptic* to mean the *plane* of the earth's orbit, and to use the word *zodiac* to denote the *great circle* in which the sun appears to move. Celestial globes or maps show the path of the sun as a great circle passing through certain constellations known of old as the signs of the zodiac. The position of the zodiac is determined by observations of the sun made with meridian instruments. If on any day of the year the RIGHT ASCENSION and the DECLINATION of the sun be determined, we can then make a mark on the celestial globe which defines the position of the sun on that day. Repeating this on various occasions throughout the year, it will be found that all the marks thus produced lie on a great circle, and that the circle thus determined remains almost exactly the same for year after year. The plane of the ecliptic is inclined to the plane of the equator at an angle termed the obliquity of the ecliptic. Its mean value on 1st January, 1885, is 23° 27′ 15·17″. The actual value during the year, or what is called the apparent obliquity, is affected by nutation, and fluctuates between a maximum of 23° 27′ 6·83″ in March, and a minimum of 23° 27′ 4·98″ in December. From the disturbances of the earth's orbit by the attractions of other planets the mean value of the obliquity of the ecliptic is not quite constant, and at the present time it is diminishing at the rate of 45·76″ a century (Leverrier). Mathematicians can, however, prove that the decrease of the obliquity will not continue indefinitely. It can only fluctuate within a limited range, which according to the most recent determination is 2° 57′ 22″. Thus the limiting values of the obliquity of the ecliptic are 21° 58′ 36″ and 24° 35′ 58″ (Stockwell).

If we could easily see stars in the daytime, then the apparent motion of the sun among the constellations would be readily detected. Even as it is, a little reflection, combined with the most simple observations, will demonstrate the apparent motion. It will only be necessary to look at certain stars or groups of stars in the heavens at a fixed hour at different seasons of the year. Choose, for instance, the Pleiads, and note simply whether they are east or west or high or low at 11 p.m. on the nights of 1st January, 1st March, 1st May, 1st July, 1st September, 1st November. Presuming that you are observing from a locality at about the latitude of the British Islands, we will describe the changes you will see. On the 1st January at 11 p.m. the Pleiads are high up in the sky, a little to the south of west; on the 1st March they will be setting a little to the north of west; on the 1st of May they are not visible; on the 1st of July they are not visible; on the 1st September they are visible low down in the east; on the 1st November they are high in the heavens, a little to the south of east; on the next 1st of January they will be in the same position as they were on the same day last year, and similar changes will ensue. It thus seems as if the Pleiads were gradually moving from the east to the west, that then they dipped below the horizon, and after a short time reappeared again in the east, so as to regain in the course of a year the position they had at the commencement. The student will be careful not to confound the *annual* motion we are here describing with the *diurnal* rising, culminating, and setting, which are due to the earth's rotation on its axis. To observe the diurnal motion we note the heavens at different hours on the same night; but for the annual phenomenon now under

consideration we observe the heavens at the same hour on different nights. Let us look a little more closely into this apparent motion. In the first place, what does 11 p.m. mean? It means that eleven hours very nearly have elapsed since the sun was on the meridian. Now, we find that at 11 o'clock on the 1st of March the Pleiads are further from the meridian than they were at 11 o'clock on the 1st of January. But as the sun is at the same distance in time from the meridian in the two cases, it is evident that the Pleiads must be nearer to the sun on the 1st of March than on the 1st of January. It is therefore plain that the relative position of the sun and the Pleiads on the heavens must be changing. By comparing the sun with other stars it is found to be a general law that the stars to the east are universally approaching the sun. We are thus coerced to one of two alternative conclusions—first, either that all the stars in the universe have an annual motion from east to west relatively to the sun; or second, that the sun has an apparent annual motion from west to east. Abundant reasons preclude the former alternative. When we consider the incredible number of the stars, their enormous masses, the stupendous distances at which they are separated, and the constancy of their relative positions, it is impossible to believe that this vast host can rapidly spin round as one fabric. Rejecting this alternative, we are forced to admit the apparent annual motion of the sun from west to east among the stars.

The path of the sun has been known from all antiquity, and as to the origin of the signs of the zodiac we quote the following passage from Professor Newcomb:—"We have no historic record of this division of the zodiac into signs, and the ideas of the authors can only be inferred from collateral circumstances. It has been fancied that the names were suggested by the seasons, the agricultural operations, and so on. Thus the spring signs (Aries, the Ram; Taurus, the Bull; and Gemini, the Twins) are supposed to mark the bringing forth of young by the flocks and herds. Cancer, the Crab, marks the time when the sun, having attained its greatest declination, begins to go back towards the equator, and the crab having been supposed to move backwards his name was given to this sign. Leo, the Lion, symbolizes the fierce heat of summer; and Virgo, the Virgin gleaning corn, symbolizes the harvest. In Libra, the Balance, the day and night balance each other, being of equal length. Scorpius, the Scorpion, is supposed to have marked the presence of venomous reptiles in October, while Sagittarius, the Archer, symbolizes the season for hunting. The explanation of Capricornus, the Goat, is more fanciful, if possible, than that of Cancer. It was supposed that this animal, ascending the hill as he feeds in order to reach the grass more easily, on reaching the top turns back again, so that his name was used to mark the sign in which the sun from going south begins to return to the north. Aquarius, the Water-bearer, symbolizes the winter rains; and Pisces, the Fishes, the season of fishes.

"All this is, however, mere conjecture, the only coincidences at all striking being Virgo and Libra. The names of the constellations were probably given to them several centuries, perhaps even thousands of years, before the Christian era; and in that case the zodiacal constellations would not have corresponded to the seasons we have indicated. An attempt has even been made to show that the names of the zodiacal constellations were intended to commemorate the twelve labours of Hercules, but this theory rests on no better foundation than the other."

EC'STASY (Gr. *ekstasis*, a change of anything from its ordinary situation or condition), a mental condition closely allied to catalepsy, though it differs from it in several important particulars. One of the chief points of difference is that the train of thought that is present during the seizure is remembered afterwards, while in catalepsy there is entire oblivion. As a disease it is seldom met with, except as part of pronounced hysteria, and its treatment must relate to that mental and physical condition of which it forms a sign. The medicines chiefly relied on are bromide of potassium, valerian, asafœtida, and ammonia; but the removal of the patient to other surroundings, and the influences of quiet and restraint, are generally the most effective means of cure.

A mental condition of this kind is such as may be brought about by the fixing attention upon one idea or emotion until it obtains full possession of the mind, causing all external phenomena to be disregarded; it has been common in connection with religious emotion from the earliest times. There are numerous references in the Old Testament to the ecstatic condition of some of the recipients of prophetic visions (see, for instance, Num. xxiv. 3, 4; 1 Sam. xix. 24), and from the letters of St. Paul it is evident that something of the kind soon appeared in connection with the meetings of the Christian churches (1 Cor. xiv.) Religious ecstasy has always been common among the inmates of convents and monasteries, celibacy and imperfect nutrition, combined with strong spiritual emotion, being conditions peculiarly favourable to its origin. Sometimes such an influence has had a contagious character, as in the cases of the convulsionaries of St. Medard, in the early experiences of Methodism, especially in the United States of America, and that of the modern Jumpers and Shakers, where an ecstatic state of mind has been found associated with violent muscular movements of an uncontrollable character. The famous dancing dervishes, and in fact very many of the more extreme of the Oriental religious devotees, are still more astonishing examples of the controlling power of ecstasy. Many truly devout and sincere persons have been ecstatics, and some of the more celebrated Christian mystics appear to have been men of this character.

EC'STASY OF PLOTINUS, the flash of rapture in which this most inspired of philosophers felt that he lost his personal consciousness and became for the time a part of the universal mind. It was the doctrine with which he endeavoured to combat the Christian dogma of revelation. Ecstasy could be attained, he considered, in three ways—by music, by love and meditation or prayer, and by dialectics carried to their highest limits, when the individual is lost in the universal, the concrete in the abstract. See Myers' finely appreciative essay ("Essays," London, 1883). See also the article PLOTINUS.

ECUADOR' (meaning "equator," owing to its being traversed by the equator), one of the Spanish American republics. It is bounded on the N. by the United States of Colombia, on the E. by Brazil, on the S. by Peru, and on the W. by the Pacific. The Andes run nearly north and south through Ecuador, and form two mountain-knots called Loxa and Los Pastos. Two nearly parallel ridges of mountains extend from knot to knot, inclosing between them a valley 300 miles long by 15 or 20 broad. Transverse ridges break up this valley into the three smaller ones of Cuenca, Ambato, and Quito. The plain of Quito is very fertile, and is 9500 feet above the sea level; the plains of Ambato, 8500 feet, and Cuenca, 7800 feet above the sea, are bare and forbidding. These plains are hemmed in by some of the loftiest summits in the world, many of them volcanic, and still showing signs of activity in frequent earthquakes and eruptions. On the eastern and western slopes are magnificent valleys of erosion. Among the highest mountains are Cotopaxi (19,500 feet), Chimborazo (20,517), Illiniza (17,120), Antisana (19,260), Cayambe (19,200). Cayambe is remarkable as being the only snow-capped mountain situated on the equator. Cotopaxi is the loftiest active volcano in the world. It occasionally throws out great masses of rock at one eruption; a mass weighing 10 tons and measuring 300 cubic feet was cast a distance of 9 miles. The

rumbling noise of the volcano is said to be audible to sailors passing along the coast. The flames rise to a height of 3000 feet above the crater. Chimborazo, meaning "mountain of snow," is an extinct volcano. As late as 1802 smoke was observed issuing from Antisana. West of the Andes smaller mountains occupy most of the space to the Pacific. East of the Andes the country is mostly a plain. The Amazon is the chief river. [See AMAZON.] Its affluents in Ecuador are the Marona, Pastaza, Tigre, and Napo. The last is the most important. It rises on the northern side of Cotopaxi, and after a course of about 500 miles joins the Amazon by several mouths. The current is very strong, and after passing the village of Napo a quick descent gives rise to some fine rapids. The short rivers which flow into the Pacific are the Patias, Esmeraldas, and the river of Guayaquil. There are numerous lakes, one of which, formed in the crater of an extinct volcano, exhales gases which stupefy birds as they fly across. It is known as Colay, and is situated to the south of Riobamba.

The temperature in the valley of Quito varies only within the limits of 48° and 67° Fahr., and the difference between winter and summer is very slight. This and the other valleys have suffered from numerous earthquakes. Near the coast the average temperature is much higher, and the distinction between rainy and dry seasons is more marked. The valley of the Amazon is very hot, and subject to almost daily rains. Agriculture varies with the altitude. Near the snow-line (15,750 feet) only a few plants grow. At about a height of 10,000 feet good pasturage occurs. From thence down to 4000 feet cereals and fruits are cultivated. At lower altitudes sweet potatoes, mandioca, yams, bananas, rice, Indian corn, sugar, cocoa, cotton, tobacco, fruits, and numerous other plants and roots, especially the valuable Cinchona plant, occur. Sheep and cattle are reared in great numbers; horses, asses, and mules to a smaller extent. The species of birds and insects are very numerous. Among the wild animals may be mentioned the jaguar, the puma, and the ounce. Many large snakes inhabit the warmer regions, while abundance of alligators are found in the rivers. Gold, silver, lead, and quicksilver mines are worked, but not so largely as in other parts of the Andes.

The population of Ecuador is composed of the descendants of the Spaniard, the Indian, the negro, and various mixtures of these, of all manner of different shades of colour. The Indians are the most numerous, and are, as a rule, very low in civilization, dirty, and lazy. The mixed races also are extremely indolent. Agriculture is the chief occupation. The country is divided into three departments, Chimborazo, Guayaquil, and Asuay. There are three roads or routes from the interior valleys to the Pacific. In many of the elevated valleys are remains of the palaces of the Incas. The manufactures of the country consist chiefly of wool and cotton, but they are of very small amount. The exports take place almost wholly from Guayaquil, from which port there is a steep road up to Quito.

Ecuador was discovered by Pizarro in 1526, and came into the hands of the Spaniards, who remained in possession of the country up to the year 1812, when it declared against them. In 1821 it was constituted part of the republic of Colombia; but this having been dissolved in 1831, Ecuador formed itself into an independent republic, and is now governed by a president, vice-president, council of state, senate, and house of representatives, which has one member for every 40,000 inhabitants. In spite of this nominally representative government, for the fifteen years from 1860 to 1875 Ecuador remained quiet under the despotism of President Garcia Moreno, who was a fanatical bigot of the most retrograde kind. He stamped out every kind of freedom, and filled the country with Jesuits, monks, and nuns, to whom the submissive congress voted all they asked, and placed the education of the country entirely in their hands. It is true he constructed some good roads and executed other public works; but he failed completely as a financier, and while neglecting to pay any dividend on the foreign debt of the country—due chiefly to Englishmen—he sent the pope an annual present of 10,000 dollars. He was assassinated at Quito on 6th August, 1875, by a Colombian named Rayo, and there has since been a very strong anti-clerical feeling in the country. Though such a clerical government may seem injurious in its very nature to the prosperity of any nation, yet it cannot be denied that the condition of Ecuador is not worse, if it is not better, than that of neighbouring countries.

Owing to there being large districts on the frontier in dispute between Ecuador and the states around, its area cannot be given with any certainty, but it has been variously estimated at 127,205 and at 248,580 square miles, the latter estimate being by planimetric calculation. Its population is about 1,000,000. On the 13th of August, 1868, the country was visited by a fearful earthquake, which destroyed several towns and not less than 20,000 inhabitants.

According to the last report of the British consul at Guayaquil, the most important article of export is cocoa, which is chiefly sent to Spain. The exports of india-rubber are extensive, but instead of tapping the trees to extract the juice, as in Brazil and other countries, the custom is to cut them down; and owing to this wanton destruction of the trees it becomes necessary every year to penetrate further into the interior. Ivory nuts are also exported in large quantities. Good cotton can be produced, but not at sufficiently remunerative prices for exportation to compete with the United States. Most of the merchandise imported is received in British steamers *via* the Isthmus of Panama. The total annual value of the imports is about £1,100,000, and of the exports £1,300,000.

EC'ZEMA (Gr., anything thrown out by heat) is a skin eruption of very common occurrence. It is a non-contagious disease, and characterized by the presence of minute vesicles hardly to be seen without a lens. These spots may terminate by the fluid in the vesicles being re-absorbed, or excoriations may form which leave a raw red surface, from which a watery liquid oozes; as the liquid dries it forms dirty scabs on the affected parts, which present a very loathsome appearance. It is a common disease, which may be produced in a great many ways. Heat may cause it, or contact with irritating substances, especially in the case of delicate constitutions or fat children. It often appears after vaccination, and in the case of the ignorant and filthy the rash soon spreads and forms fetid scabs, which lead people to imagine that their children are suffering from some loathsome disease. Much prejudice has in this way arisen against vaccination, while the fact is, that although vaccination is undoubtedly attended with some slight constitutional disturbance, the eczema which occasionally follows is always curable by a little care and cleanliness. Moistening the part with olive oil, applying a linseed meal poultice, and then a little zinc ointment, is a course to which the complaint soon yields.

Eczema of the leg in the case of aged people, and in those who suffer from varicose veins and ulcers, is a more troublesome and obstinate form of the disease. It requires tonic medicines, warm baths, and the local application of appropriate lotions.

Where eczema assumes a chronic or recurrent form it also requires constitutional as well as local treatment. The functions of digestion and assimilation must be assisted by the exhibition of tonic medicines, which must be selected according to the constitution of the patient. Of external applications the oxide of zinc ointment has the most soothing effect on the eruption, and zinc powder suspended in

lime water forms a lotion which not only exercises a beneficial effect, but greatly allays the distressing itching which characterizes this complaint. The parts affected should be kept covered where it is possible, and washing must be avoided until the eruption has been conquered and a new skin formed.

ED'DA. The northern mythology, which in regard to wild imagination and sublime conception surpasses that of Greece or Rome, is chiefly contained in two collections called "The Eddas," which have been handed down from time immemorial by the scalds, or ancient minstrels, of Denmark, Sweden, Norway, and Iceland. The word Edda signifies mother of poetry. In the beginning these mythological records were communicated from mouth to mouth, and afterwards written down with the sacred characters of the north, the Runic characters, an alphabet which the Scandinavians are said to have obtained from the seafaring Phœnicians. The Scandinavians initiated the Saxons in the mysteries of their religion, but the latter were forced by Charlemagne to exchange it for Christianity. After the conquest of the Saxons by Charlemagne the worshippers of the religion of Odin withdrew to Iceland, where the sacred books of the Scandinavians were preserved, from which Sæmund Sigfusson, a Christian priest, and Are Frode, the historian, collected, between the years 1056 and 1133, the older Edda.

This important work was concealed and forgotten for nearly 400 years. However, in the year 1643 a copy of these poems was found by Bishop Svensen, and published in three vols. 4to, containing the original text, a Latin translation, and a dictionary of the northern mythology. The contents of the poems are prophecies, elevated conversations, and magic songs.

The new Edda, composed or arranged by Snorro Sturleson, a hundred years later, is divided into three books: one, a systematic prose compendium of the former; the second, a long poetical vocabulary; and the third, a grammar of Scandinavian prosody as used for the compositions of the scalds or bards. Snorro was educated by Sæmund's grandson. The Icelandic text of this second Edda was translated in the year 1640 by Resenius, and hence it is called the Resenian Edda, as the older is called Sæmund's Edda.

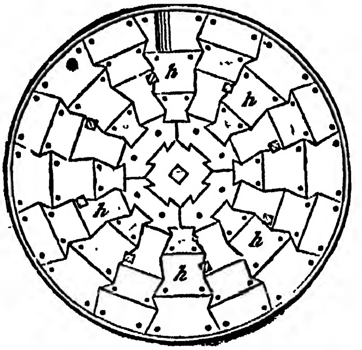
ED'DYSTONE, a group of rocks situated on the south coast of England, in the English Channel, about 9 miles south-west from the Ramhead and 14 from Plymouth, and a little to the north of a direct line between the Start Point, in Devon, and Lizard Point, in Cornwall, being about 40 miles from the former and 30 from the latter. They are of gneissic formation, and consist of three reefs, known as the western, southern, and northern, with small rocks dotted about irregularly. Owing to their position with regard to the Atlantic and to their standing in deep water, the force of storms from the south-west falls upon them with unbroken fury, and although the Atlantic may be perfectly calm the ground swell left by previous gales will frequently keep the water around the rocks in a stormy turmoil for days together. In the finest weather in some places the waves, suddenly checked, may be seen rising to a height of 30 or 40 feet, rendering landing an impossibility. But though these rocks were evilly famous in former times for the dangers they offered to navigation, they are now yet more famous for the lighthouses that human skill has placed upon them, and so far are they from being considered objectionable that when a proposal was made to remove them by blasting it was strongly opposed, on the ground that they were of the greatest value as affording a platform for the exhibition of a light which was an essential link in that chain of lights by which navigators are able to choose the best course possible along the English Channel.

The first lighthouse was erected by Henry Winstanley, a gentleman of Littlebury, in Essex. The building was commenced in 1696, the principal work of that year being the fixing of twelve great iron stanchions into the rock. The second year a solid pillar of masonry was erected round these stanchions; in the third year a tower of wood and masonry, 18 feet in diameter and 80 feet high, containing rooms for the keepers, was finished; and on the 14th November of that year, 1698, a light was for the first time exhibited. During the succeeding winter the work suffered somewhat from the effects of the sea, and the lighthouse was strengthened by 4 feet of masonry built round it from the foundation, and so completed in 1699. The drawings of this first lighthouse represent a somewhat fantastic structure, nevertheless it stood and showed its beacon light for five years. The architect had such confidence in his work that he declared that he wished he might be in the lighthouse "during the greatest storm that ever blew under the face of the heavens." His wish was gratified, for on 26th November, 1703, an unprecedented storm found him within it. Unfortunately, however, it swept away the whole tower, with the keepers and workmen, and Mr. Winstanley himself. Nothing was left but a few of the iron stanchions that had been first fixed into the rock.

For two years and a half no attempt was made to rebuild the lighthouse. Then the erection of a second lighthouse was intrusted to Mr. Rudyerd, a silk mercer, of Ludgate Hill, London, who commenced his task 6th July, 1706, in a most masterly manner. He very carefully fixed thirty-six club-headed iron bolts in the rock so as to inclose a circle 23½ feet in diameter; then he cut the sloping rock into steps so as to get a succession of flat surfaces, on which he laid a series of solid oak balks, the alternate layers of which were placed crosswise. This structure was carried a few feet above the highest point of the rock, being fitted together as solidly as possible, and fastened firmly to the iron uprights let into the rock; next followed five courses of Cornish moorstone laid without cement, but cramped very strongly together with a multitude of iron cramps, then two more courses of solid timber. This solid structure reached about 9 feet above the top of the rock, then for the next 18 feet were similar alternate courses of wood and stone, except that a well was left in the centre with a passage to the door. Around this mass of timber and masonry, 27 feet high, was fixed a casing of upright timbers, scarfed together and firmly fastened to the oak courses. This outside casing reached 34 feet above the solid masonry, thus forming four rooms, one above another, for the keepers. All the outside timbers were strongly caulked with oakum like a ship, and the whole surface covered with pitch. Above this structure, 61 feet high, was fixed the lantern, which was lit with twenty-four candles of three to the pound. The light was first shown 28th July, 1708, although the building was not finally completed till the following year. For forty-seven years this lighthouse resisted the fury of the winds and waves, until in December, 1755, it was accidentally burned down.

This building was the property of shareholders, who held a lease of the reef from the Trinity House. Of this lease more than fifty years were unexpired, and the shareholders, acting under the advice of the Earl of Macclesfield, then president of the Royal Society, applied to John Smeaton to reconstruct the building. Having most carefully considered the best form to give his tower in order to resist the forces to which it would be opposed, Mr. Smeaton selected the oak for his example, and in July, 1756, he submitted his plans for a stone tower, which were unanimously approved, and he was given full authority to carry out the work in the manner he should deem most advisable. Smeaton's plan was so to dovetail all the stones into the rock and into each other as to make the whole mutually interlock together, and form, as it were, one solid mass. He also spent immense pains in testing the

various natural limestones adapted to form water cements, and finally selected blue lias lime, which effectually answered his purpose, though it is inferior to Portland cement, which is an artificial product of comparatively recent invention. On 3rd August, 1756, work was commenced, the rock being cut into steps in a more efficient manner than had been done by Rudyerd, and these steps being also cut into dovetails to receive the stones. Accurate drawings of every course of stone in the whole structure were prepared (copies of which may still be found in Smeaton's published account of his work), and every stone was carefully fitted before being carried out to the rock, so that the building was always "in a condition to resist a storm at every step." The annexed sketch represents the course of the dovetails and position of joggles, *h h*, by which the work was closely bound together. The first six courses were completed in 1757. Next year the solid portion, consisting of twenty-four courses, was completed, and on 17th August, 1759, the main column was finished; then the lantern was set up, and the light, 72 feet above high water, was kindled on the 16th October, not a single life or limb having been lost in the execution of the work. Up to the 17th May, 1882, its light shone forth over the waters. Nature, however, had given way, and



for some years it was subject to tremors of an alarming character. A careful inspection was made in 1877 by Sir Richard Collinson, the deputy-master, and the elder brethren of the Trinity House, accompanied by their engineer, Mr. Douglass, when it was discovered that the rocky foundation had been undermined by the waves, and that although the tower itself was sound the portion of the reef upon which it rested had become insecure. The construction of a new lighthouse had therefore become imperatively necessary. Operations were commenced in July, 1878, under the direction of Mr. Douglass, who together with his father had been imprisoned in Smeaton's lighthouse for several days, during which no boat could approach the reef, and he had therefore enjoyed peculiarly favourable opportunities of studying the nature of the forces which the building was called upon to resist. From this experience and from subsequent study he arrived at the conclusion that the shape of Smeaton's tower, which tapered upwards in a curve from the foundation, was not the best that could be designed, and that by allowing the waves to run up readily towards the summit this shape had the effect of throwing the main stress of the water upon the upper part of the tower, where it acted with enormous leverage to weaken the base. Mr. Douglass, in his designs for the new lighthouse, had therefore to devise means of diminishing the effect of the upward strokes of the waves, and of giving increased strength to the foundation, upon which, probably, a relatively greater amount of shock would be thrown. For this purpose he determined to place the curved portion of the tower upon a base with vertical sides, which would not have the same tendency to produce an upward run of the waves, and also to lay the foundation in a manner somewhat different from that which Smeaton had employed.

The old lighthouse was built upon a portion of the reef which, in ordinary weather, is just at the level of high water, and which affords no more than room for the structure placed upon it; but Mr. Douglass chose a portion at the northern extremity of the southern reef, the middle of the three. It is entirely submerged at high water, and is the summit of a sort of platform of rock, slightly convex in its general form, thus having a somewhat broad base at a lower level than its central part. The foundation of the building being below the water level, it was requisite in the first instance to construct a brick and cement coffer-dam, inside which the men could proceed safely with their boring and cutting operations, and eventually with the setting of the lower courses of the masonry, for the brief three or four hours which then constituted a maximum tide's work. In these operations no gunpowder was used for fear of shaking the adjacent rock, the whole of the cutting and levelling being accomplished by "jumpers"—heavy iron bars, sharp at each end, worked by hand—assisted by a patent rock-boring drill worked by compressed air. This was the first occasion on which such an instrument had been employed in the erection of a rock lighthouse, and it proved itself to be a very useful auxiliary in this branch of marine engineering, the work which it was capable of executing being equivalent to that which can be done by ten "jumpers" plied by the most brawny Cornish miners. In the central part an excavation was made to receive the foundation, and the stones of the lowest course were bolted to the rock by bars of yellow metal, which passed into the solid gneiss below to a considerable depth, and were made to expand beneath by being driven home upon wedges.

During 1879 518 hours of work were performed and the first eight courses laid. In 1880 the thirty-eighth course was completed. In 1881 the tower was finished, and consisted of 2171 stones, the whole weighing 4668 tons. The lower part of the tower consists of a cylindrical platform 44 feet in diameter and 22 feet high, the upper surface of which is 2 feet 6 inches above high-water of spring tides. The top of this forms a promenade 4 feet 6 inches wide, extending all round the tapering tower, the diameter of which is 35 feet 6 inches at the base and 18 feet 6 inches at the cornice, which is 138 feet above the rock. The cylindrical portion is solid, and the tapered portion, with the exception of a water tank, is solid for a further height of 23 feet; at this level the walls are 8 feet 6 inches thick, diminishing to 2 feet 3 inches at the top. It contains a sort of entrance-hall and eight rooms above it, in addition to the lantern, the seven uppermost rooms being 14 feet in diameter.

The light consists of two colza oil lamps placed one above the other, each having six concentric wicks, which, instead of Rudyerd's twenty-four candles, have an illuminating power of a quarter of a million candles. The height of the focal plane of the light in the old house was 72 feet above high water, and was visible 14 miles, while that in the new house is 133 feet, and is visible 17½ miles. It is a white, double-flashing, half-minute light, showing two successive flashes of 2½ seconds' duration, and there is also a subsidiary fixed light shown from a window of the lighthouse to mark the *hand deeps*. In foggy weather a powerful bell, weighing 2 tons, is sounded twice in quick succession every half-minute, the character of the sound-signal being thus assimilated to that of the light.

The tower is entirely of granite from the De Lank quarries at Wadebridge, near Padstow, in Cornwall, with the exception of seven courses in the lower part of it, from Aberdeen. Every stone was completed at the quarry

and marked for the place it was to occupy. The bottom blocks are 6 feet 6 inches long by 3 feet 10 inches wide and 2 feet thick, and the stones throughout the whole structure are dovetailed by projections and grooves into those above, below, and on each side of it, and all joints are filled with Portland cement, which is almost as hard as the granite itself.

Smeaton's tower has been taken down and re-erected upon Plymouth Hoe. On the 20th October, 1882, the Duke of Edinburgh relaid at Plymouth the first stone of the edifice which had for so many years done good service to the mariners of the world. It is a fitting and noble monument to Smeaton's genius, and has been the model on which all other stone lighthouses have been since designed.

In our Plate we give sectional views of Smeaton's lighthouse, constructed in 1759, and of that of Douglass, completed in 1882, and drawn to the same scale.

E'DEN (Heb., pleasure or delight), the first residence of man, according to the book of Genesis, where also a brief and obscure account is given of its geographical situation. From the earliest times it has been the aim of such commentators as accept the story as a literal narrative to find a locality that corresponds to the description given, but these efforts have been entirely without success. The writer of this portion of the book of Genesis refers to its situation as being "eastward," and speaks of a river which parted into four heads, which he names Pison, Gihon, Hiddekel, and Phrath. The two latter rivers are universally identified with the Tigris and Euphrates, but innumerable conjectures have been made to account for the other two and the regions they are said to have compassed.

Another school of commentators, abandoning altogether a literal interpretation of the story, have found in the garden of Eden a symbol of the soul. Philo, taking this view of the narrative, found in the tree of life a symbol of religion whereby the soul is rendered immortal, in the tree of knowledge the faculty of discerning things contrary to nature, and in the four rivers the virtues of prudence, temperance, courage, and justice.

Both the literal and mystical interpretations have received the support of eminent scholars, but recent Assyrian discoveries have cast an altogether fresh light upon the matter, and a comparison of the Babylonian legends of the creation and early history of man may possibly indicate the source from which the story has been derived. It is now generally admitted that the spiritual significance of the narrative is that which gives it importance, and that considerable latitude in the interpretation of its details must be permitted. (See George Smith's "Chaldean Account of Genesis," London, 1876.)

EDEN (River). See CUMBERLAND.

EDENTA'TA is Cuvier's name for an order of MAMMALIA comprising the ant-eaters, sloths, and armadillos. The name Edentata implies that the animals thus grouped

Skull of the Armadillo.

together are toothless; this is the case, however, only with the true ant-eaters (Myrmecophaga) and the pangolins (Manis). In all the teeth are extremely simple in structure, being destitute of roots and enamel, and never being replaced by a second set. There is a conspicuous deficiency of teeth in the front part of the jaws, both incisors and canines being usually totally absent. The molar teeth, on the other hand, are sometimes numerous, between ninety and 100 being found in the jaws of the great armadillo (*Priodontes gigas*). The name Edentata is now replaced by BRUTA, under which heading the other characters of this group are noticed.

ED'FU, a village in Upper Egypt, on the left bank of the Nile, has about 2000 inhabitants, and is remarkable only as the site of one of the largest and best preserved of the ancient Egyptian temples, on the roof and in the precincts of which the huts composing the village are built. The inhabitants manufacture earthenware vessels, to which they give the forms represented on Egyptian tombs. See EGYPTIAN ARCHITECTURE.

ED'GAR, surnamed the *Peaceable*, the youngest son of King Edmund I. by his wife Elgiva, was born about the year 943. He ascended the throne in 959, following his brother EDWY. He had been, by election, King of Mercia, and now became supreme King of England, and the celebrated Dunstan became his chief counsellor. The government of the kingdom, under the guidance of this ecclesiastic, was unquestionably conducted with remarkable ability and success. Throughout the whole of his reign England remained undisturbed by war; the northern pirates were during his life deterred from showing themselves on the English coasts by the powerful naval force that was kept up by the king. Another work of great public benefit which is attributed to him is the reformation of the coinage. England had never before been so thoroughly at one as under Edgar, and the well-known legend is worth repeating how the great king's barge was rowed on the river Dee by eight faithful and submissive tributary princes—viz. Kenneth of Scotland, Malcolm of Cumberland, Maccus of the Isles, and five Welsh princes. Edgar has been chiefly lauded by the monkish annalists for the restoration of the church both to its ancient possessions and to a more perfect state of discipline than it had probably ever before known. Under the vigorous administration of Dunstan the married clergy were at length removed almost to a man from the cathedrals and abbeys; and no fewer than fifty-four monasteries were founded or restored in different parts of the kingdom, and filled with monks as well as richly endowed. They were all subjected to the Benedictine rule. Edgar died in 975, and was succeeded by his eldest son Edward, afterwards designated the Martyr.

EDGEWORTH, MARIA, a celebrated Irish novelist, was the daughter of Richard Lovell Edgeworth, and was born in Oxfordshire in 1766. Her numerous works, many of them written in conjunction with her talented father, have perhaps been more instrumental in promoting the cause of education and pure morality, and in the inculcation of refined taste, than those of any other contemporary writer, and amid the ever-varying tastes of the age her productions still continue to be read and admired. She commenced her literary career about 1800, and the celebrated "Essay on Irish Bulls," which was the joint production of herself and her father, made its appearance in 1801. This was soon followed by other works that did not fail to attract public attention, as "Castle Rackrent" and "Belinda," which abound in admirable sketches of Irish character and manners. In 1804 appeared her "Popular Tales," and in 1806 she published the novel of "Leonora." In 1809 she brought out a work of more powerful and varied cast than any of her previous productions, entitled "Tales of Fashionable Life." In 1812 she issued her second series of "Fashionable Tales," in three volumes, which fully sustained the literary reputation she had now so deservedly acquired. In 1814 appeared her novel of "Patronage." Her excellent and numerous tales for children are not the least valuable part of her writings. She died in 1849.

E'DICT, a magisterial decree. The famous *Edictum prætoris*, or prætor's edict of ancient Rome, was a sort of body of common law revised annually by the prætors as

they took office. It was rendered necessary by the multitude of cases which necessarily arose when Rome became mistress of the world, beyond the purview of the Ancient Laws of the Twelve Tables, which had been drawn up for the republic in its first youth. [See DECEMVIRI.] Accordingly the prætor or chief magistrate of Rome (dimly comparable to our lord chancellor) when he ascended his tribunal gave out by a herald, and afterwards had painted upon a wall, the edict or decree of the various principles he should follow in certain often recurring cases, and the relief which his equity would afford from the precise rigour of the ancient statutes. The art of respecting the ancient laws, while tempering their severity, was improved by successive prætors. Wills were set aside, contracts annulled, very much as in our Court of Chancery, if injustice was made out to be done to the satisfaction of the prætor. As each prætor issued his own edict, a yearly opportunity was afforded of correcting this body of law, and it had grown so complete by the time of the Emperor Hadrian that he ordered Salvius Julius, the great lawyer, to frame a *perpetual edict*, which was done. As Gibbon says, "This well-digested code was ratified by the emperor and senate, the long divorce of law and equity was at length reconciled, and instead of the twelve tables the perpetual edict was fixed as the invariable standard of civil jurisprudence. Hadrian was the first emperor to assume in this way the functions of a legislator; previous sovereigns had always issued laws in their capacity as prætor, as consul, as tribune," &c. But imperial authority once set going, the successors of Hadrian made up for lost time, so that the mass of edicts, constitutions, &c., grew vaster and less manageable reign by reign, till at length JUSTINIAN ordered the famous CORPUS JURIS CIVILIS to be composed, and the world gained a starting point for all subsequent legislation. But all this mighty edifice grew out of the simple prætor's edicts, at first hardly noticed, except as a matter of administrative convenience, and existing for centuries as custom before they began to take the force of law.

EDICT OF NANTES, a charter granted on the 30th April, 1598, by Henry IV. of France, and which, while it remained in operation, was the charter of Protestant liberties in that country. By it the Huguenots were declared eligible for public posts, and the exercise of their religion was, under certain conditions, declared free. Their petitions and suits were judged of in a specially constituted "Chambre de l'Édit," which in some cases was composed of half Catholics and half Huguenots. The edict, however, was often evaded owing to the opposition of the clerical party, and it was entirely revoked by Louis XIV. in 1685, when the persecutions of Languedoc began. One consequence was the emigration of large numbers to England, where they introduced the silk-weaving industry. There are still in London and some other places communities of descendants from these refugee Huguenots.

EDINBURGH or **MID-LOTHIAN**, a county of Scotland, is bounded N. by the Frith of Forth, N.W. by the county of Linlithgow, N.E. by that of Haddington, E. by that of Berwick, and S.W. and S. by portions of the counties of Lanark, Peebles, Selkirk, and Roxburgh. Its form is irregular. Its medium length is about 24 miles, and medium breadth about 15 miles. The area is 362 square miles, or 231,724 acres. The population in 1881 was 389,164—an increase of 61,000 as compared with 1871.

The Lammermuir Hills, here known as the Moorfoot Hills, extend throughout the whole of the south-eastern portion of the county. They belong to the Silurian formation, and consist almost entirely of gneissic rocks. The highest summit is Blackhope Scar, 2136 feet above the sea. Near the summit of the Soutra Hill stood formerly a church and village, with an endowed hospital for the relief of pilgrims. The Pentland Hills extend from Lanarkshire into the central part of the county, running from S.W. to S.E., at an elevation of from 1600 to 1900 feet above the sea. On their summits boulders of granite are found whose original site has been traced to Dunkeld and Ben Lomond. The loftiest summit is Scald Law, 1898 feet high. The county between the Lammermuir Hills and the Pentland Hills, and north of the Pentlands to Linlithgowshire and the Frith of Forth, is generally undulating. The strata of limestone and freestone are valuable, and a portion of the Scotch coal-field is in the county.

The Breich Water flows N.E. from the north-western point of the county, and joins the Almond Water, which also flows N.E. into the Frith of Forth, these rivers dividing the county from Linlithgowshire. The Linhouse Water is a tributary to the Almond Water. The Water of Leith rises in the north-western ridges of the Pentland Hills, receiving in its upper course many small affluents, and flowing N.E. and N. falls into the Frith of Forth at Leith. The North Esk rises among the north-eastern ridges of the Pentland Hills, and flows N.E. past Dalkeith. The South Esk rises in the north-western ridges of the Lammermuir Hills, and flows N. till it unites with the North Esk below Dalkeith, where the united stream, then called the Esk, flows N. to the Frith of Forth at Musselburgh. The beautiful stream called the Logan Water rises in the eastern ridges of the Pentland Hills, and flowing E. and S. falls into the North Esk at Auchindinney. The Crawley Spring, from which Edinburgh and Leith are supplied with water, is near the Logan Water, at the eastern edge of the Pentlands. The Gala Water rises in the Lammermuir Hills, and flows S. and then E. through Roxburghshire to its junction with the Tweed.

The soils are of the greatest variety, from the finest loams to gravels and stiff clays. Among the Pentland Hills and Lammermuir Hills are much moorland and moss. Draining has been carried on extensively, by which and by heavy manuring even bad soils have been made highly productive. The rotation of crops is different in different parts of the county. A large proportion of the county is appropriated to the production of grain, fruit, and vegetables for the supply of Leith and Edinburgh. According to the last published official agricultural statistics there are about 135,000 acres, or five-ninths of the entire area, under cultivation. The farming throughout the county is unusually good, the farms being generally large, and the tenants having capital, enterprise, and a sound training. In the spring the county is visited by cold and dry east winds, but the harvest is a week earlier on the coast than at a height of 200 feet inland, and a fortnight earlier than at a height of 600 feet.

The chief manufactures in the county are those of paper, carpets, gunpowder, iron goods, bricks, candles, and leather. Limestone and sandstone are extensively quarried; paraffin oil is obtained from bituminous shale; and there are fifteen collieries in the valley of the Esk, where the bed is 15 miles by 8 in extent, and contains thirty-three seams varying from 1 to 6 feet in thickness. In the Frith of Forth there is a productive fishery, and large quantities of cured fish are exported to Germany, Holland, and Russia.

Edinburgh returns one member to the House of Commons—number of electors in 1886, 18,017; in addition to which four members are returned for the city of Edinburgh, and one for the Leith district of burghs, which comprises Leith, Musselburgh, and Portobello.

Edinburgh county was included in the Roman province of Valentia and was afterwards comprised within the kingdom of Northumbria, from 446 to 1020. Though many towns show a Celtic origin in their names, yet most of the villages and castles bear Saxon titles. There are several remains of early military works, tumuli, and hut circles; the "Cat Stane" on the Brigs farm near Kirkliston has been conjectured to mark the burial-place of the grandfather of Hengist and Horsa. Roslin Chapel, founded in

1446, is a most interesting specimen of Gothic architecture; and Roslin Castle, on the banks of the Esk, is a fine ruin. Craigmillar Castle, Borthwick Castle, Crichton Castle, and Dalmahoy Castle, containing the Bible of the Scottish Parliament and the warrant for committing Queen Mary to Lochleven, are all places of interest.

EDINBURGH, the metropolis of Scotland, and the capital of the above county, is situated in 55° 57′ 28″ N. lat. and 3° 10′ 30″ W. lon. It stands upon a group of hills separated by deep depressions. On the highest of the hills the Old Town is built. The ascent to its summit forms a street upwards of a mile long, in nearly a straight line from the Palace of Holyrood on the east, about 120 feet above the level of the sea, to the castle, which is elevated upwards of 380 feet above the same level, and is accessible only on the eastern side, all the others being nearly perpendicular. The fine landscape visible from this point is powerfully described in Scott's "Marmion."

The origin of the name "Edinburgh" is interesting. Its Gaelic form was *Dunedin*, town of Edin or Edwin. In fact it is *Eadwinesburh*, burh or town of Eadwine or EDWIN, King of Northumbria (then running up to the Forth), Bretwalda of all England, first Christian king of the north, and the greatest prince of his time. He fell in battle, 633 A.D. The site was evidently chosen owing to the capabilities of defence offered by a bold cliff of trap rock upon which the castle was erected. In the year 1128 it is called by David I. *his burgh of Edinburgh*, whence we infer that it was then a royal burgh. It was not a walled town till the middle of the fifteenth century. In 1537 it was almost entirely burned down, and its destruction was completed in a raid by the Earl of Hertford shortly after, so that few buildings remain of a date earlier than this. James IV. encouraged the erection of its first printing press, in the beginning of the sixteenth century; but it was not till the succeeding reign that it was recognized as the undoubted capital of Scotland, though, as presenting the safest place of refuge for the king and the government for protection from the nobles, its leading position dates from the assassination of James I. in 1436. From this time its history merges in that of the kingdom. Its inhabitants were converted to the Protestant faith at an early period of the Reformation; and the great bulk of them adopted the Calvinistic creed, and adhered rigidly to the Presbyterian form of worship. John Knox was for some time minister of St. Giles' Church, Edinburgh, where he preached twice on Sundays and three times every other day of the week; and the house which he inhabited (at the Netherbow, near the east extremity of the High Street) is still standing. The union of the kingdoms excited great tumults in Edinburgh with the view of intimidating those members of the Scottish Parliament who were favourable to the obnoxious measure. The Act, however, was eventually passed (1st May, 1707) without bloodshed. In the rebellion of 1715 an unsuccessful attempt was made by the Jacobites to surprise the castle. In the subsequent rising of 1745 the rebels got possession of the city, a party of the Highlanders having secured the Netherbow Port; and they remained masters of the town from the 15th September to the 31st October. But finding it impossible to reduce the castle, they abandoned the city and proceeded on their march to England. In 1736 a remarkable occurrence took place in Edinburgh, known by the name of the Porteous mob riots. On the 14th of April, at the execution of a smuggler of the name of Wilson, a disturbance arose, and the executioner and city guard were assailed by the populace. Porteous, the captain of the guard, having ordered his men to fire on the crowd, six people were killed and eleven wounded. Having been tried for the offence before the High Court of Justiciary, Porteous was condemned to death, but was reprieved by the crown. Resolved, however, that he should not thus escape the fate which they thought he merited, the mob, on the evening of the day previous to that on which he was to have been executed, broke into the gaol in which he was confined, and having dragged him out, led him to the usual place of execution, and there hanged him by torch-light on a dyer's pole. It being supposed that the municipal authorities had neglected their duty on this occasion, the city was ordered to pay a fine of £2000 sterling to the widow of Porteous; and though a reward was offered, the perpetrators were never discovered. The union of the two kingdoms checked the advancement of Edinburgh; but very great improvements and enlargements have been made within the last seventy years.

Among the chief buildings of the city is the castle. It is now a place of little strength, and its buildings are chiefly modern. It derives its interest from the associations connected with it and its own formidable appearance. It contains the *Honours of Scotland*, or the Scottish Regalia, and was the birthplace of James I. of England. At no great distance from the castle stands the Parliament House with the courts of justice. In the first of these the Parliament of Scotland met between 1640 and the Union. The hall now forms the Outer House of the Court of Session, and in its immediate neighbourhood are rooms appropriated to the Inner House and to the courts of justiciary and exchequer. The courts of the sheriff and justices of the peace are held in the county hall; and near this are the buildings in which are deposited the valuable libraries of the advocates and writers to the signet. The fine Gothic fabric popularly called the Cathedral of St. Giles is also in this neighbourhood. A "new church" was erected here by Alexander I. about 1120, but was burned along with the rest of the city by Richard II. in 1385, and only some pillars in the choir now remain of this ancient building. But the church was immediately rebuilt, and added to from time to time. It was after the Reformation broken up into four separate places of worship. The number of separate churches under the single roof at various times was reduced from four to three, and then from three to two, until at length in 1883 the whole of the vast area, from east to west and from north to south—nave, choir, transepts, and aisles—was restored at the expense of Dr. William Chambers, and again opened up so as to form a single church, under a single but manifold roof. Its cruciform shape, never quite perfect owing to the truncated transepts, has been destroyed by the addition from time to time of memorial aisles both on the north and on the south side of the building, and the area has, therefore, assumed a somewhat irregular shape. The main building consists of a solid parallelogram, measuring about 200 feet by 70 feet. To this there are added three small extensions on the north, and one large one on the south, measuring 122 feet by 22 feet, the latter being still further extended by three smaller aisles contiguous to one another and projecting into Parliament Square. It was close to this church that the Old Tolbooth gaol stood, pleasantly named the "Heart of Midlothian." On the opposite side of the street is the Royal Exchange, with the common council-room and other offices of the magistracy; and in the centre of the street, a little way down, is a radiated causeway to mark the site of the old market cross. In Princes Street the banks, clubs, &c., attract attention. On the Mound are the National Gallery of Art and the Royal Institution, containing the apartments of the Royal Society and the Museum of the Society of Antiquaries. The New College, belonging to the Free Church, stands conspicuously at the head of the Mound. A handsome Episcopal cathedral, in the Early English or "Lancet" style, was erected in 1879.

Edinburgh is divided into three principal parts—the Old Town, the South Side, and the New Town—each of which has its own peculiar features and character. The Old Town

is intersected by the street previously mentioned; on each side formerly descended in regular lines a multitude of narrow wynds, closes, and styles, which on the south led for the most part into the Cowgate, a confined street running along the southern base of the hill. Over this street the South Bridge and George IV. Bridge are thrown, to connect the Old Town with the South Side. The South Side is built on rising-ground, less lofty than the central hill. On a line with the South Bridge is the North Bridge, thrown from the slope of the Old Town ridge to the rising-ground which forms the site of the New Town. The New Town having been erected according to regular plans, conceived in a spirit of improvement, the greatest regularity and beauty characterize its buildings, streets, and squares.

To the west the New Town is gradually stretching to the village of Corstorphine; to the east the buildings are increasing in the direction of Portobello; and to the north, it may be said to be connected with Granton, Newhaven. and Leith, on the shore of the Frith of Forth. The increase of houses in the South Side has been very great. Taking as a centre the Grange Cemetery, in which Thomas Chalmers, Hugh Miller, William Cunningham, Sir Andrew Agnew, and many other noted Scotchmen are interred, the locality now known as the Grange reaches Morningside on the west, Newington on the east, and the Melville Drive, Meadows, on the north. The houses in the Grange are almost all inhabited by the wealthier classes.

The access to Princes Street from the South Side is, for pedestrians, by the Lovers' Lane, the central walk of the Meadows, George IV. Bridge, Bank Street, and the Mound; for carriages, by Newington, Nicholson Street, South and North Bridges. A street, named after Lord Cockburn, communicates with the Waverley Station of the North British Railway. The terminus of the Caledonian Railway is at the west end of Princes Street. To the east of the New Town is the Calton Hill, and to the south-east Arthur's Seat.

Below this is the street called Canongate, at the foot of which are the palace and abbey of Holyrood. The abbey is said to have been founded by David I. about 1128 in gratitude for his rescue from an infuriated stag by the interposition of a miraculous cross. The abbey was dedicated to the Holy Rood, and the privilege was granted to the canons to build a burgh between their church and the Netherbowport of the city, whence the name Canongate is derived. The abbey and the royal apartments were burnt by the English in 1544, but were rebuilt. A great part of the palace was again burnt at the close of the Civil War. Charles II. built the present palace, which was for some time the residence of the Comte d'Artois, afterwards Charles X. of France. On the summit of the Calton Hill some columns of a National Monument have been erected, and stand in solitary grandeur. They mark not only the futility of ambitious designs commenced without sufficient means to complete them, but an undesigned resemblance to the true but dilapidated modern Athens. Near them are the observatory, and the monuments to Dugald Stewart, Playfair, Burns, the Scottish political martyrs, and a few other persons. On the low ground, towards the west, is situated the Calton Gaol; and at the east end of Princes Street stands the General Register House, where the public records of the kingdom are preserved, and the register of all deeds conveying or charging territorial property. The university buildings [see EDINBURGH UNIVERSITY] are between the South Bridge and Nicholson Street. There are numerous places of worship for the various religious denominations.

Edinburgh has some noble hospitals and charitable institutions. Among these are—the Royal Infirmary, opened in 1880; Heriot's Hospital, Watson's Hospitals, Merchant-Maiden and Trades-Maiden Hospitals, Donaldson's Hospital, Orphan Hospital, Chalmers' Hospital, and Gillespie's Hospital; Longmore Hospital for Incurables; Institution for the Deaf and Dumb, Asylum for the Blind, Magdalen Asylum, and Lunatic Asylum. Most of the banking-houses of Edinburgh are large edifices; such in particular are the Bank of Scotland, the Royal Bank, the British Linen Company's Bank, and the Commercial Bank. The Scott Monument, in Princes Street, finished in 1844, is a work of remarkable merit. A memorial of the Prince Consort, in Charlotte Square, consisting of a bronze equestrian statue, was unveiled before the queen in 1876. In the New Town are the theatres, clubs, &c.; but literary and scientific institutions are more numerous than those for mere pleasure. The most striking modern educational establishment in Edinburgh is the Fettes College, at Comely Bank, near the Dean Cemetery. It is in the Scottish baronial style, and was completed in 1868. The institution is the result of a bequest of Sir William Fettes, of Comely Bank, who died in 1836 and left the residue of his estate —ultimately amounting to £280,000—for the education, and in some cases the maintenance and outfit, of boys whose parents died without leaving sufficient funds for their education.

Much has been, and is still being, done to improve the sanitary condition of Edinburgh. The water with which the city is supplied is derived from the Pentland and Moorfoot or Lammermuir Hills.

In recent years a great deal of rebuilding has been carried on in the city, which has necessitated the removal of many of the high, blackened, picturesque old houses which gave so much of its peculiar character to the city. From an artist's point of view it is impossible not to regret the demolition of many of these old structures, but on sanitary grounds their removal was an absolute necessity.

Edinburgh has no manufactures of importance, but printing and publishing are carried on to a greater extent than in any other town in the United Kingdom except London. There are also some extensive type foundries and breweries.

Edinburgh returns four members to the House of Commons. The government of the city is vested in thirty-nine councillors, from among whom are chosen a lord provost, a dean of guild, a treasurer, and six bailies. The population in 1881 was 228,357, and the number of parliamentary electors in 1886 was 27,947. The city is 387 miles in direct distance from London, and 399 by railway.

EDINBURGH UNIVERSITY, founded by royal charter of James VI. in 1582, when the magistrates of the city were constituted its patrons, originated in a bequest of Robert Reid, bishop of Orkney in 1558. In 1583 the well-known Robert Rollock was appointed its first regent or principal. Rollock continued for some time its only teacher. Soon, however, the thirst for knowledge which had been awakened by the Reformation attracted a number of youths belonging to the upper classes to the newly instituted school, and other professors were appointed. The first chair of theology proper was founded in 1642, and the first chair of medicine in 1685. The faculty of arts and the faculty of laws were formally constituted about 1710. In 1760 the senatus academicus consisted of one principal and eighteen professors. Its present number is one principal and thirty-eight professors. The winter session opens in the beginning of November, and closes in the end of April, and is assigned to the preparation for the Master of Arts degree; the summer session opens in the beginning of May, and closes in the end of July, and is for law and medical students. The university court consists of the rector, the principal, the lord provost of Edinburgh, and the five assessors. The senatus academicus consists of the principal and professors. In 1858 the government of the university was taken out of the hands of the magistrates and lodged in the courts just named. The patronage of fifteen of the chairs is in the hands of seven curators, three of whom are appointed by the university and four by the town council; the

rest are either held by the crown or by other authorities in conjunction with the curators. The degrees granted are those of Master of Arts, Bachelor of Medicine, Master of Surgery, Doctor of Medicine, Bachelor of Science, Doctor of Science, Bachelor of Divinity, Bachelor of Laws, and Doctor of Laws. Matriculation is obtained by entry of the students' names in the General Matriculation Album of the university.

There are about 800 bursaries, fellowships, and scholarships in connection with the university. They are appropriated to the different faculties, are in the patronage of the senatus, the town council, and of private individuals, and are of the annual value of from £5 to £120. They are generally held for four years. Neither the students nor professors reside in the university, an arrangement which, though rendering expenses far less than in English universities, has its disadvantages.

The university library consists of about 145,000 printed volumes and 2000 volumes of manuscripts. It is open to students on payment of their matriculation fee, under such regulations as may be made from time to time by the Senatus Academicus, and is also available to members of the General Council on payment of an annual subscription. It was formerly one of the institutions that were entitled to a copy of every book entered in Stationers' Hall, but this was commuted for an annual sum of £575 paid by the government. The library hall is 198 feet in length by 50 feet in width, and is generally acknowledged to be one of the finest halls in the kingdom. The theological faculty has a library, consisting of above 10,000 volumes, appropriated to the use of its own students. The natural history museum contains good zoological, geological, and mineralogical collections. The whole of these have now been removed from the rooms occupied by them in the university buildings to the natural history department of the new Museum of Science and Art. In 1883 there were opened new class-rooms, theatres, &c., for the medical faculty of the university in the immediate vicinity of the new Royal Infirmary. The botanical gardens are in connection with the university, and there are several valuable museums in connection with special classes. All the divinity, most of the law, and many of the medical students prepare themselves for their special courses by taking the general arts curriculum. The number of students averages 3000 annually. By the Scotch Reform Act of 1868 the university was joined to that of St. Andrews for the purpose of returning one member to Parliament.

ED'MONTON, a village of England in the county of Middlesex, with a station on the Great Eastern Railway, 11 miles from London. The village consists of Upper and Lower Edmonton. Many new villas and cottage residences have been built of late years, and it has become a populous suburb. The Bell Inn has been connected by Cowper with the immortal adventures of John Gilpin. Charles Lamb died here in 1837. Population of the parish, 23,463.

E'DITH, or more correctly **EAD'GYTH** (pronounced somewhat like *Yadgyth*), was a favourite name in Older England before the Norman conquest. The principal persons of the name were the following:—

1. Edith, daughter of King Edward the Elder, who married Otto the Great, afterwards king of the East Franks. After Edith's death he became Emperor of Germany.

2. St. Edith, a nun, daughter of King Edgar.

3. Edith, daughter of Ethelred the Unready, whom that king married to Eadric Streona, his low-born favourite. See Edric.

4. Edith, the Queen (or Lady) of Edward the Confessor, daughter of the great Earl Godwin, was married, as a piece of statecraft, to the gloomy half-Norman fanatic who filled the throne; but though she shared his crown she was never admitted to any further wifely privilege, from some fanatical superstition as to saintliness which formed one of the many monkish ideas of the king. When her father and brothers were exiled in 1051 for their efforts in resisting the invasion of the Norman favourites, with whom the king was filling every English office, Queen Edith was at once banished to Wherwell, and stripped of everything she possessed. She only resumed her honours when her kindred returned in 1052. She favoured her brother Tostig, earl of Northumbria, and was even accused of causing the murder of one Gospatric, who had come to court to complain of Tostig's arbitrary rule. Tostig was banished eventually, just before the death of the Confessor, and returned in arms almost at once after Harold (his brother) was chosen king. Edith was held to favour Tostig's invasion. However that may be, William the Conqueror, finding her at Winchester, the second city of the kingdom, after the fatal battle of Hastings, merely demanded tribute of her, which was at once paid. Winchester was the lady's dowry. It is possible she might have come to share her husband's fondness for Normans, and if so did not look unwillingly on Duke William's conquest. Whatever the reason they seem to have remained in peaceable if not friendly relations.

5. Edith of the Swan's Neck (*Eadgyth Swanneshals*), mistress of King Harold, who alone was able to recognize his body after the battle of Hastings, for the king's face had been mangled into shapelessness by the ferocity of the victors.

EDMUND I. (*Eadmund Magnificus*), King of England, was the son of King Edward the Elder, by his third wife, Edgiva (*Eadgifu*). He was born about 923, and succeeded his half-brother, Athelstan, 27th October, 941. He had fought at Brunanburh by his great brother's side, though he was but eighteen at his accession. His name stood so high that all the jarring states which then made up England accepted his election, except the Danes in Northumbria and Mercia. Edmund at first agreed to a partition with the Dane Anlaf like that of his grandfather Alfred with Guthorm; but after Anlaf's death he made renewed efforts, and by 944 reduced the entire kingdom to allegiance. To reward the Scots for assistance rendered he made Malcolm, king of Scots, Prince of Cumberland in 945. The reign of Edmund, who was distinguished by his taste for elegance and splendour, and for his imposing qualities of mind, whence he was called The Magnificent, was terminated, 946, by his assassination by an outlaw of the name of Liofa. Abbot Dunstan (one day to become St. Dunstan) buried him in his abbey at Glastonbury.

King Edmund I. left by his wife, Elfgiva, two sons, Edwy and Edgar (*Eadwig* and *Eadgar*), who eventually both sat on the throne; but as they were mere children, his immediate successor was his brother Edred.

EDMUND IRONSIDE, or **EDMUND II.,** King of England, was the son of King Ethelred II., and was born A.D. 989. The name of his mother, and even his legitimacy, has been disputed. He appears in the history of the later years of his father's calamitous reign as the chief champion of the English cause against Canute and his Danes, who had by this time nearly overrun the kingdom. On the death of Ethelred in 1016, Edmund was proclaimed king by the burgesses of London, and soon afterwards at least all the kingdom of Wessex submitted to his authority.

The short reign of Edmund was nearly all spent in a continuation of the sanguinary struggle in which already he had so greatly distinguished himself. Five hotly-contested battles were fought, of which the sites are disputed; one is known to have been fought at Otford in Kent, the Danes being defeated with great slaughter; and one at Assandun (Assington in Essex), in which, through the treachery of his ealdorman Edric, who, with a large part of the force, deserted to Canute during the battle, Edmund

was defeated. After this Edmund and Canute, it is said, agreed to decide their quarrel by single combat. The encounter took place on an islet called Alney, or Olney, in the Severn, and Canute was obliged to yield and sue for his life. Whether the single combat took place or not, it is certain that an arrangement between the parties was now made, by which Mercia and Northumbria were made over to Canute, while Edmund retained possession of the rest of the kingdom, even including the Danelagh, with the nominal sovereignty of the whole. Edmund, however, died a few weeks after this pacification, having worn the crown only about seven months; and there are strong reasons for believing that he was made away with by the traitor Edric. Canute immediately mounted the vacant throne, 1016. Edmund Ironside left by his wife, Ealdgyth, two infant sons—Edward, afterwards called the Outlaw (because he fled abroad for safety), and Edmund.

ED'MUND, ST. (*Eadmund*), King and Martyr, was ruler of the subkingdom of East Anglia. About 870 the Danes invaded his kingdom, under Ingwar and Hubba, and Edmund, stoutly resisting them, was beaten and made prisoner. They honoured his courage, and offered him his life and his kingdom if he would rule as under-king with them instead of with the English kings of Wessex. Furthermore, he was to leave the worship of Christ for the altars of Odin. Edmund indignantly refused, and he and his bishop met with the fate of St. Sebastian. The fierce Danes tied him to a tree and riddled his body with arrows. In the churches of Norfolk and Suffolk pictures of the martyrdom are not uncommon. Miracles were worked at his tomb in after times, and it was easy to obtain his canonization from Rome.

E'DOM. See IDUMÆA.

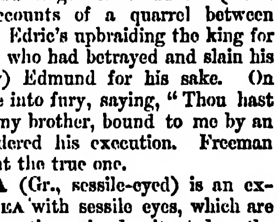
ED'RED (*Eadred*), King of England, was the youngest of the sons of Edward the Elder, his mother being Edgiva (*Eadgifu*). [See EDWARD THE ELDER.] Edred succeeded his brother Edmund the Magnificent in 946, Edwy and Edgar, the two sons of Edmund, being excluded for the present by their extreme youth. Edred, soon after his accession, repressed in person an insurrection of the turbulent Danish population of Northumberland. A distinguished character of this reign was St. Dunstan. Edred died, after a reign of between nine and ten years, in 955, and was succeeded by his nephew Edwy.

ED'RIC (*Eadric*), surnamed *Streona*, was a favourite of the weak and unfortunate Ethelred II., surnamed the Unready. He was of low birth, but so thoroughly in the favour of the king that he was given the Princess Edith in marriage. He was one great cause of the popular hatred of Ethelred's rule, which made the country so ready to accept the Danish conquest. The chief earls were dispossessed at his bidding, and Earl Ælfhelm of Deira was murdered by his order. Money and honours were grasped on all sides, and finally he became Ealdorman or Earl of Mercia. Such a man was sure to bite the hand that fed him; and we are not surprised when we read how Edric first betrayed his master's army to the Danes in 1009, and then openly joined the invaders. He was present at the martyrdom of St. Alphege (*Ælfheah*) at London, at Eastertide, 1012, when the good bishop refused to allow men to pay his ransom to the heathen. But when Ethelred came to the throne again in 1014, Edric once more changed sides; to show his renewed loyalty he set fire to St. Frideswide's Church (now Christchurch Cathedral), Oxford, where some of the chief Danes had come to confer with him. Ethelred was base enough to receive the goods of the murdered men from the traitor's hands, and his son, Edmund the Atheling, married the widow of the wealthiest (Sigeferth), and straightway went into the Danelagh and occupied all their estates. In 1016 Canute came, while Ethelred lay sick to death. Canute seized Wessex, and though Edmund, now earning his famous surname as the "Ironside," held the greatest part of Mercia, Edric considered his time had come to turn again. Accordingly, he not only joined Canute, but raised a considerable force, marched against Edmund, and while parleying with him attempted (unsuccessfully) his assassination. Afterwards, in 1016, when King Canute (crowned by a witan at Southampton, Ethelred being dead), came face to face in battle at Sherstone with King Edmund (holding his sceptre by the vote of a witan at London), Edric found a dead soldier very like the Ironside, and hacking off his head, cried out, "Flee, English, flee! dead is Edmund!"—a disgraceful trick which nearly cost the Ironside the day. Nevertheless—it is almost incredible when we read it—the Ironside proving the greater warrior, and steadily growing in power, traitor Edric once more turned coat and went over to King Edmund. He swore fealty, and Edmund foolishly trusted him. He had his reward; for at the great fight at Assandun Edric drew off with his forces, and allowed Canute to gain the victory. What was the price of this crowning treason we know not. Edmund's death the same year was by all men laid at Edric's door, whether rightly r not, and Canute made him Earl of Mercia on his accession. But as soon as Canute felt secure on his throne—in less than a year—Edric met his long-merited doom. The Chronicle says—"This year (1017) was Eadric Ealdorman slain, in London, very rightly." Florence of Worcester is more explicit:—"And on the nativity of our Lord, when Cnut was in London, he bade the faithless Earl Eadric be slain in the palace, because he feared that he might some time be entrapped by him with snares, as his former lords, Æthelred and Edmund, had often been entrapped by him; and he bade that his body should be thrown over the wall of the city and left unburied." William of Malmesbury and Roger of Wendover (much later chroniclers) give accounts of a quarrel between Canute and Edric, and of Edric's upbraiding the king for not doing more for him, he who had betrayed and slain his "brother" (brother-in-law) Edmund for his sake. On this confession Canute rose into fury, saying, "Thou hast slain thine own lord and my brother, bound to me by an oath?" and thereupon ordered his execution. Freeman considers Florence's account the true one.

EDRIOPHTHAL'MA (Gr., sessile-eyed) is an extensive group of CRUSTACEA with sessile eyes, which are generally compound, but sometimes simple, situated on the sides of the head. The head, thorax, and abdomen are distinct. There is no thoracic carapace, and the segments of the thorax and abdomen are distinct and well developed. The branchiæ are connected with the organs of locomotion. The sexes are distinct. As a rule there are no distinct larval forms, the full development taking place within the egg.

The Edriophthalma are divided into two orders, Amphipoda and Isopoda, to which a third, Læmodipoda, is sometimes added.

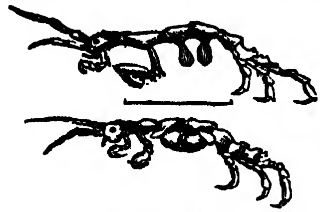
The amphipods have their branchiæ or gills in the form of large membranous vesicles placed at the base of the walking thoracic legs, on their inner side. The thorax is composed of seven free segments, each with a pair of walking legs. The abdomen is well developed, and of seven segments, and its appendages are elongated, narrow, and fringed with hairs. The three hinder pairs are bent backwards, and, along with the terminal portion of the abdomen, form a sort of fin, which serves the animal for swimming or leaping. The females carry their eggs under the thorax, between certain scales or vesicles at the base



Common Sand-hopper.

of the legs, which form a kind of pouch. In this position they are hatched, and the young remain attached to the legs, or other parts of the body of the parents, until they gain sufficient strength to swim and take care of themselves.

The body of an amphipod is laterally compressed and has great muscular power. One of the commonest species of this group is the Sand-hopper (*Talitrus locusta*), found in great numbers on the British coasts, living between high and low water mark, burrowing in sand, and feeding on decaying seaweed and animal matter. Its leaping powers are very great. In the order ISOPODA the abdomen, instead of carrying swimmerets, carries plate-like bodies which have a respiratory function. The Læmodipoda are forms most of which should be regarded as degenerate amphipods. The Skeleton Shrimps (Caprella) have the abdomen quite rudimentary, the first thoracic segments fused with the head, and the first two pairs of legs attached to this part. They are found on our coasts among marine plants, creeping along in the same way as the "looping" caterpillars, often bending themselves back with great rapidity, and applying their antennæ to various parts of their body, while in swimming they bend the two ends of the body downwards. The Whale-lice (Cyanus), parasitic on whales, should probably be placed with the Isopoda.



Caprella linearis—Male and Female.

EDUCATION (Lat. *educo*, I lead forth) is the *science* of human culture and the *art* of training the faculties of man to their best uses and their highest results. It has been called "the Georgics of the soul." By it the young are prepared for the proper fulfilment of the duties of civilized life. Man is the true "Wealth of Nations," and education seeks to realize all that is in man as man. It aims at securing the healthy growth and due development of all the activities of the body, mind, and will, so that each person may be able to have a fair start in life and to act well, as members of the community, under a right sense of all life's responsibilities. The teacher moulds what is plastic, trains what is pliant, exercises all the innate and actual powers of his pupils. Education cultures all human capacities so that men may receive and impart happiness. It is man's real outfit for social existence. As such education presents itself in three aspects—(1) Hygienic, (2) Mental, and (3) Moral or Religious. It shows us how, 1st, to nourish the child in bodily health and to cherish in it feelings of love and goodness, with a knowledge of right and duty; 2nd, to awaken and exercise the mind's perceptions of nature and conceptions of truth; 3rd, to inform the intellect and habituate it to know, admire, desire, and do what is right; 4th, to enlighten and discipline the conscience, and at length incline and enable it to feel, think, and act as a responsible moral agent.

When considered as an applied science education comprises the following parts:—1. *Primary* or Elementary, including reading, the means of acquiring a knowledge of the thoughts of others by signs; writing, the means of communicating our thoughts to others by signs; arithmetic, the means of computing, by signs, the numbers and quantities of things; object lessons and history—by the former we are taught something of nature above, below, and around us, as well as the laws by which it is regulated; and by the latter we gain some knowledge of the race to which we belong, its doings, duties, and hopes. 2. *Disciplinary* or Secondary—all that improving information which goes to make a man able and wise, the *gymnastics* of the mind, *e.g.* grammar, physiography, mathematics, literature, classical training, health-science, political and social economy, and the practical acquisition of modern languages. 3. *University* or Liberal Studies—all that superior culture designed to make thought a pleasure and learning a refining delight. 4. *Professional*—those branches of knowledge which are necessary for exercising the higher vocations, *e.g.* of artist, author, diplomatist, journalist, lawyer, linguist, merchant, physician, preacher, statesman, scientist, teacher, &c. 5. *Technical* or Industrial, manufacturing and artistic—the special training required in agriculture, arts, commerce, engineering, and manufactures. 6. *Supplementary*, under which may be ranged all those studies and pursuits which are of interest to the individual and for the time, as biography, numismatics, bibliography; those gratifying to the curiosity or the taste, as archæology, conchology, æsthetics; those calculated to bring men together sympathetically from a common bent of mind, fancy, or hobby; as well as the ordinary every-day information required in common life, such as is stored up in almanacks, classified in handbooks, and met with in newspapers.

A somewhat more scientific or theoretical outline of education or systematic pedagogy arranges its matter into these groups:—1. *Physical*—that which makes and keeps the body healthy; trains it to usefulness, pliancy, and elegance; and induces, by gymnastic drill and athletic exercises, skill of muscle and nerve, acuteness of sense, and handy readiness of frame. 2. *Instrumental*—(1) elementary, as reading, writing, and arithmetic; (2) technical, as drawing, a knowledge of the use and manipulation of objects, products, machinery, &c.; (3) mental: words and their uses, composition, bookkeeping, &c.; (4) professional: the arts and duties of business, office, factory, workshop, warehouse, field. or shipboard. 3. *Informing*, as grammar, geography, history (civil and natural), government, taxation, finance, the progress of events, and an acquaintance with topics of every-day interest and necessity. 4. *Culturing*, as logic, rhetoric, mathematics, science (physical and social), philosophy (ethical, mental, and political), statistics, language and literature (ancient and modern), criticism, &c. 5. *Moral*, *i.e.* relating to duty—personal, family, civil, social or legal. 6. *Political*, concerning the rights and responsibilities of citizenship in private, public, or official life. 7. *Philosophical*, in regard to (1) the theory of life, thought, and action, and the legislation founded on it; (2) scientific ethics and sociology, the history of systems of thought on man, life, and society. 8. *Æsthetic*—(1) the knowledge, practice, and enjoyment of the fine arts; (2) the perception of the sublime and the beautiful, and the delight derived from natural scenery; (3) the nature, uses, and pleasures of poetry and imaginative literature. 9. *Religious*, dealing with (1) personal piety; (2) public worship, and the rights and duties of fellow-worshippers; (3) the special duties of members, adherents, and officials in relation to their own and other creeds; (4) social efforts and home influence, &c.; (5) missionary enterprise—home and foreign; (6) individual example, state regulations, and church arrangements; (7) public worship or national recognition of God. A theory of education may also be presented to the mind in (1) its nature, (2) its form, and (3) its limits; in its particular elements, as (1) physical, (2) practical and moral, and (3) intellectual; and in its special systems, as (1) theocratic, (2) national, or (3) humanitarian. These are next found dealing with, *a*, personal culture; *b*, special callings; *c*, the duties of home and citizenship.

History.—The history of education leads us to trace the means employed in the training of children under patriarchal rule, as in the earlier races of the earth; in the family circle, as in China; in tribes, as among many savage people; in castes, as in India and other Oriental lands; for military purposes mainly, as in Persia, or for priestly ones, as in Egypt and among the Celtic Druids.

It was pursued in ancient Greece with a philosophical design, and in Rome with a practical one. In mediæval Europe and in modern Tibet an ecclesiastical bent prevailed; in America, Germany, and France a political intent to a large extent regulates it. It has not been pursued in the past with the single object of making the best of a man for himself, and doing the best with him in society—as the culture of life. Hence we require to trace its course through slight indications of facts brought together and arranged by a few theoretical links. In the primitive forms of life the chief lessons of the young would be to obey at home, to help with the flocks or toil in the fields, and to refrain from offences against parents, friends, and neighbours. So long as pastoral and agricultural occupations prevailed, this or little more sufficed. When tribes became nomad, and the bow, the spear, the sling, and the crook were employed, skill in them would be taught. In the dawn of civilization only the priests and their assistants required mental training and moral culture. Hieroglyphics wrapped up their professional secrets for cure of body and for care of soul. Among the Jews the schools of the prophets were training colleges for the brighter minds among the people of Palestine. The study of the law, hieratic writing, music, poetry, and the order of nature was pursued in them. The pupils learned to compose annals, give counsel, expound the sacred books, and prepared themselves to receive and execute the commissions of the Divine Spirit when he had need of them. After Solomon had wisely advised the Israelites to "train up a child in the way he should go," some mode of education seems to have been adopted; for we read of "the bringers up of the children" (2 Kings x. 5), as well as "tutors and governors" (Gal. iv. 2); and the prophets straitly charged parents to teach their children concerning the works and ways of God.

Similar institutions for priestly culture existed in other Eastern lands, and thus there arose the distinction between clergy and laity, which has continued through so many ages, and passed even into Western states.

The Greeks looked on strength of sinew and beauty of body as of vast importance. To secure these the Dorians invented gymnastics. We know from Homer that the higher classes were trained in oratory, statesmanship, and war; learned the myths and legends of their country, and were versed in poetry, music, and medicine. A highly educated priesthood existed both in Greece and Rome. Learning, however, was not confined to that class. The love of wisdom—philosophy—was the leading mark of the Hellenic race. Their zeal for culture called forth a class of teachers—the sophists—who popularized the knowledge and fashioned the opinions of their ages. Socrates taught men to exercise their minds for the discovery of truth. He was the gymnast of the intellect, training it to see, think, and act. Plato, the earliest systematic writer on education, could not easily satisfy himself with a theory. In "Phædrus" he advocates search for the true, practice of the good, love of the beautiful. He explains in "Theætetus" what true knowledge is. Ideal good is discussed in "Philebus," practical good in "Charmides." The beautiful is expounded in "Hippias Major." In other dialogues of singular dramatic liveliness, moral enthusiasm, and keen logic, he treats of holiness, virtue, courage, wisdom, &c. In the "Laws" (ii.) and the "Republic" (vii.) he gives two different forms of his ideal of education—that it is the production, in a healthy body and a sound mind, of right desires and fitness for citizenship. Xenophon's "Cyropædia" is imaginary rather than historic. He, like Plato, thought education was the art of forming the citizen. His schoolmasters are those who are likely to make the best boys. His pupils are taught justice, self-control, and gratitude, and trained to use the bow, the javelin, and the sling. The value of such discipline is exemplified in that "Life of Cyrus." With Plato education was the *former*, with Aristotle the *informer* of the soul. The latter by his "Organon" became for centuries the trainer of the human race. Right thinking was with him the key to true knowledge, which is experience understood.

Athens became the university of Rome. Schools existed in Italy for instruction in reading, writing, and arithmetic; but Greek was the language of culture. Cicero and Quintilian, our great authorities on Roman education, show us that the course of study embraced composition, oratory, mental and moral philosophy, &c. But though many Greek teachers dwelt in Rome, it was usual to resort to Athens for the higher instruction. Cicero thought men should be trained in virtue, amiability, and greatness, and in subordinating all their faculties to what is practical in time and circumstances. Quintilian recommended Greek to be learned even before the mother tongue. Both being rhetoricians gave an undue bias to the study of the plausible. Ability and pliability formed, in their ideal, a complete man; and hence they advocated dexterity in the elementary subjects, readiness in speech, and knowledge of myths, legends, poetry, and history. The pedagogue regulated life and manners; the schoolmaster inculcated instruction and exercised the mind; the father governed the character and will. In this Rome imitated Greece; in neither did the million—the helots and slaves—obtain any education.

The Christian church received from its Founder the command to "teach all nations." In this lay the germ of popular education. All the great schools and communities of scholars were connected with the church and its missions. Fitness for life and duty were less preached than strength of faith and similarity of creed. During the middle ages the clergy and the laity were clearly distinguished. The monks were taught *that* and *what* they might teach. The *trivium* (grammar, logic, and rhetoric) and the *quadrivium* (music, arithmetic, geometry, and astronomy) formed the seven pathways of knowledge. The knight was taught to ride, fence, shoot, swim, box, hawk, play chess, and sing love songs to his lute and his lady. The toiling masses tilled the soil and wrought at handicrafts. The merchant classes established guilds. Professions developed and apprenticeship provided for such technical education as was required. Charlemagne, desiring to rule over an enlightened people, set schools afoot in the chief cities of his empire. He enjoined the bishops to see that the children in their dioceses were learned in grammar, arithmetic, music, and gospel truth. Greek poetry was committed to memory, and astrology was a favourite pursuit. The impulse to higher studies came from the Arabs, Jews, and Moors of Spain. These sought to restore the culture of Athens. They translated Greek writers into Arabic. At Bagdad and Cairo universities were founded, and thousands thronged them. The Eastern empire reimpregnated the Western with the love of letters. Byzantine Greeks gave skill to the intellect, but left the heart untouched. The institution of universities and the cultivation of modern tongues; the culture in writing, the multiplication of books, the study of the Roman law, and the need which thus arose for a renewed examination of the Latin language, excited the minds of men and increased the number of those who sought knowledge. Learning revived.

Gerard Groot in the northern Netherlands founded the Society of the Brethren of the Common Life in 1340. Under this pupil of Gerson and friend of Ruysbroeck, favoured by the dukes of Brabant and the counts of Holland, schools spread from the Scheldt to the Vistula, teachers were trained, manuscripts were transcribed, and instructive books were written. When printing made books readily accessible schools increased rapidly. Scholars like Erasmus passed from land to land, carrying the torch of knowledge as they went. Luther's appeal from pope

to people carried the need of learning into the cottage. Melancthon, "the preceptor of Germany," and his friends urged the attainment of knowledge. Where the revival of letters and the Reformation moved together schools multiplied. In Germany the nation's leaders were educationists. So were they in Scotland. Knox, Buchanan, and Melville are as noted in scholastic as in national or ecclesiastical history. In most other lands education was dealt with mainly as a minor branch of religion and an outlet for benevolence. Schools were mostly benefactions or church pertinents. Montaigne insisted that "we have not to train a *soul*, nor yet a *body* only, but a man," and he objected to giving children "a smattering of everything in general, but nothing to the purpose in particular."

The practical systems of instruction pursued by Valentine Trotzendorf of Goldberg and John Sturm of Strasburg became the models on which the grammar or classical schools of Germany were formed. Jerome Cardan gives, in his little "Book of Precepts" and in the account of the training of his children, both proverbial and practical illustrations of his theory of culture. The Jesuits took the management of education in the Papal states. Under the Jansenists at Port Royal a collegiate life was led which almost realized the fascinating fancy of Milton. But Arnauld, Pascal, and Nicole's "garden of ease and grace" failed before the hot zeal of their opponents. Wolfgang von Ratich proposed an improved school system to the German diet (1612). J. A. Comenius, an Austro-Slav and a Moravian brother, devoted his life to improving the instruction and discipline of schools, and making man through them surely, easily, and solidly wise and holy. He is the chief of modern didactic educationists. Ascham had before this written his "Schoolmaster" (1570), and Mulcaster his "Positions" (1581). Milton, through Hartlib, had been led to study Comenius, and to compose his "Tractate on Education." The Commonwealth Parliament entertained the idea of endowing a universal college for "the advancement of learning" on Bacon's ideal. Then the times changed and enthusiasm waned. John Locke's "Thoughts on Education" (1690), though discursive and irregular, advocates the careful development both of body and mind in manliness, wisdom, and virtue.

These great writers had not yet reached the idea of education for all. Defoe spoke a strange doctrine to English ears when he, about 1692, in an "Essay on Projects" protested against making women "only stewards of our houses, cooks, and slaves;" and uttered this general principle—"The soul is placed in the body like a rough diamond, and must be polished, or the lustre of it will never appear. And 'tis manifest that as the rational soul distinguishes us from brutes, so education carries on the distinction, and makes some less brutish than others." In 1745 Bishop Butler announced the view "that children had as much right to have some proper education as to have their lives preserved;" that "they ought to be instructed and exercised in what will render them useful to society, secure them from the present evils they are in danger of incurring, and procure them that satisfaction which lies within the reach of human prudence;" and that "the public are as much interested in the education of poor children as in the preservation of their lives." A century and a quarter elapsed before these thoughts ripened into legislation in England.

Meanwhile, "Emile," a romance of education, by J. J. Rousseau, which maintained that man should have a strong, serviceable body, well-trained muscles and nerves, and ought not to be required to obey, but be led by comradeship, grew into encyclopædism and the Revolution in France, and roused men to consider anew the nature and need of education. Kant philosophized on *paideutics*; Goethe in "Wilhelm Meister" (B. ii.) supplied his ideal of training a living mind for living its life aright; Fichte explained "the vocation of man" and of "the scholar" to be "duty, intelligence, and effectiveness." Herbart taught that education was "the transmission to a new generation of the results of the accumulated experiences of the race." Basedow's "Philanthropin," a model school founded to realize Rousseau's views, though supported and imitated by Campe, Kolbe, &c., failed; and only Salzmann's institution at Schnepfenthal, near Gotha, conducted on Basedow's principles, survived the Revolution. Pestalozzi, stirred by "Emile," proclaiming that vice and misery arose from ignorance, entered on a crusade against their cause. Men's souls were inflamed by his zeal; he moved Europe to undertake in some fashion the cultivation of souls as well as soils, and education became the enthusiasm of the age. Poets sang of it, philanthropists established societies to promote it, projectors of systems of teaching sprung into notoriety and influence, politicians sought to have schools diffused, the church had its interest quickened, and the political economy of scholarship took "a new departure." Frœbel founded the KINDERGARTEN. The worth of man as an article of culture, and of education as a national industry, gained public attention.

The United States of America.—In the early national legislative recognition of education America holds a distinguished place. There universal suffrage and universal education condition each other, and the culture of humanity is brought within the sphere of the state. One of the earliest Education Acts of the original colonists of Massachusetts Bay, incorporated in 1628, was passed in 1632. It required householders to give "their children and apprentices as much learning as would make them able to read perfectly the English tongue, and know the capital laws" which they were bound to obey. A law making the support of schools compulsory and education free and universal was enacted in 1647. This was confirmed in 1692, reaffirmed in 1780, and expressly made a state law in 1789. An "appropriation," either in taxes or in land, is set aside in each school district for the proper and adequate provision of instruction in each township, and since 1835 a permanent fund for the support and encouragement of education has been established. The management of this fund was by the legislature intrusted to a board of education in 1837. This has formed the model on which the Atlantic, the central, the western, the Pacific coast, and the southern states have all, though at more recent dates and with several slight differences, moulded their school system. The plan is so elastic and expansive, in regard to course of studies and thoroughness of instruction, that it may be utilized in all places and adapted to all wants. The state demands that suitable schools shall exist and be maintained in a given population. It leaves the nature of the school buildings, the choice of teachers, the supply of books, and the oversight of the instruction in the hands of the local committee; and though it decrees that children must be taught, it leaves the enforcement of the law mainly with the local administrators. In most cases the schooling is free, the Bible is read, but doctrines are not taught. The teachers are examined and certificated, generally by local boards. Normal training schools were instituted in Boston in 1839, and have multiplied greatly. Schools are usually open to boys and girls, though each sex is taught apart. The classing of schools has been found difficult, a closer community of interest among teachers and between teachers and their employers being required; and greater uniformity of administration has been aimed at, since the great war has made the union more compact, and the benefit of education more felt and better appreciated. The American statistics of education are very complete, and the reports of the bureau of education highly valuable.

Germany.—Among the states of Europe, Prussia long enjoyed the highest reputation for the excellence of its provisions for the education of the people. Not only in it, but in many of the other territories aggregated into the

German Empire in 1871, the obligation of parishes to provide and children to attend school was taught among the minor morals, and was soon embodied in law. It was felt that the moral and intellectual well-being of the people depended on the training given them, and hence school instruction was made the subject of careful legislation. In 1722 Frederick William I. in Prussia established a directorium for the management and examination of the schools under the control of the crown. Frederick the Great laid down in the "Landrecht" the principles on which legislation on education is to this day based in Germany. Aided by Von Stein and Von Harden Frederick William III. sought by education to reorganize the state. A government department of education was, by the advice of Wolf, Schleiermacher, and Humboldt, instituted, and put under a responsible minister in 1817. Its regulations are of the most thoroughgoing sort. Inspection prevails through the whole course of the schools. The folk, village, or parish school is controlled and managed by a committee of magistrates, clergymen, and householders in the district. "Every inhabitant who cannot or will not procure the necessary education for his children at home is bound to send them to school as soon as they have reached five years of age" (Code II. xii. 43). This school-duty is compulsory till the completion of the fourteenth year, under penalty of (1) fine, (2) imprisonment, and (3) withdrawal of child from their care and putting it in public ward. These schools are supported by a school-rate levied on householders and landowners, unless from poverty the state requires to give imperial aid. This rate must provide (1) suitable salaries and retiring allowances for teachers, (2) proper schools for teaching and exercise, (3) furniture and apparatus, and (4) free schooling to the poor. Besides elementary schools, larger places and towns must have *burgher* schools, to provide for higher instruction, and *gymnasien*, for giving a general scientific culture, or *realschulen*, supplying practical training for business and life. Test examinations regulate the passage from class to class and from school to school. There are also infant schools, orphan schools, and *rescue* schools, for the care of bereaved or parentally neglected children. Teachers are trained in normal schools, and must be certificated for capacity and morality. Where population allows and opinion requires, schools for Protestants and for Catholics must be held separately. Where the pupils are of "mixed" creed religious education is given in the schools by the clergymen of the parish, who have the general care of the theological teaching given in village schools.

Similar educational enactments prevail in *Denmark*, *Switzerland*, and the minor members of the German States' Confederation. Though in *Austria* and *Hungary* education has since 1849 been placed in charge of a minister of public worship and instruction, there are some peculiarities in which it differs from the German-speaking states. Boarding and technical schools are more numerous. Nearly the whole expense of instruction is provided for from general and local taxation, and is, through all grades, in the main gratuitous. Education is almost entirely under the management of the clergy, especially the Jesuits. Great care is devoted to technical or special training, and to the promotion of science and art.

France owes to a voluntary association, founded in 1815 on the model of our British and Foreign School Society, the initiation of the present national system of popular education. It was reorganized as "a Society of Public Utility" in 1831. Louis Philippe (who once himself acted as a schoolmaster in Switzerland) bestowed in 1833 the great educational charter which forms the legal basis of the school system of France. It was introduced by Guizot into the chamber of deputies, passed, and has succeeded beyond the expectations of its promoters.

At the request of the Count de Montalivet, minister of public instruction and worship, M. Victor Cousin and Marc Girardin made a thorough investigation of continental education; and founding on their reports, the ground-plan of French instruction has been laid out. A special minister of education superintends the whole machinery of culture. Prussia was most influential in suggestiveness. Half of the cost is borne by the departments and half by the national treasury. Teaching is free, from primary school upwards. Every school is inspected. Teachers, whether of public, private, or denominational schools, must have their diploma. Every commune must have its school, and religious teaching is given in all. Normal schools are numerous; colleges and schools for instruction in special branches—agriculture, forestry, farming, arts, trades, and the applications of science—abound. Colleges for preparation for the civil, military and naval services, and academies for instruction in law, literature, medicine, science, and theology, are well distributed. Recently the establishment of technical schools and commercial academies has received much attention, and the compulsory provision and reception of education has been insisted on. Books, methods, apparatus, buildings, appointments, dismissals, retirements, &c., are all regulated by the administration. The public teacher is a civil servant.

The law regulating the employment of children in manufactories in France provides that no child under eight years of age shall work in a factory; all between eight and twelve so employed must attend school, and the same obligation is imposed on those under sixteen, unless they can produce a certificate to show that they have received a sufficient degree of primary instruction.

Holland.—In the Netherlands each district must have, at least, one elementary school, supported by the local public funds. All teachers undergo examination before being permitted to teach, and all schools are under government inspection. Religious instruction is excluded from public schools, whether elementary or higher. On this account several societies have been instituted to provide private schools in which religion may be taught. There are national normal schools; but these societies have a normal school of their own. Attendance is not compulsory, but the teaching is solid, thorough, and useful. Athenæums and other institutes supply the higher training under the supervision of the universities.

Russia.—Education in Russia has not yet been thoroughly nationalized. Village schools are upheld mainly by voluntary funds; the gymnasia in the provincial towns are in some cases endowed, in others supported from the imperial treasury. Poor students are allowed maintenance at these and the universities. There is a minister of education, and many improvements in the diffusion, organization, and teaching of schools followed the abolition of serfdom.

Italy.—Since the union of the Italian peninsula into a kingdom great efforts have been made to increase elementary schools and to provide for adequate instruction in them. Normal schools, following the British model, have been established, and as teachers are prepared they are speedily "placed out" in new public and endowed schools. The educational progress made is of happy promise, because the ministry are acting with judgment and toleration. Higher education has also been remodelled and extended.

India.—In each presidency of India there is a director of public instruction, who has under him a body of trained inspectors, by whom the schools in the several circles are overlooked. Primary or popular schools have been instituted; secondary and middle-class schools of two sorts are provided, and a university in each presidency "crowns the edifice." The schools are supported in part locally and in part out of the public exchequer; schools for natives, taught by native schoolmasters properly trained, are numerous; and technical colleges have been established in many of the large centres of population.

Japan.—A social and political revolution in Japan, in 1868, led to the recognition of the importance of education. The new government established a bureau of education, introduced a number of teachers, and sent into different countries a selected number of youths to be trained intellectually and technically. A large number of these, besides several English and American teachers, have been put in charge of schools. English is taught. America has been chosen as the model of their system of free schools and colleges. The governmental arrangements are very thorough; and caste having been abolished, great energy has been devoted to the promotion of a system of education for all classes, conducted under and inspected by the state.

England.—It took England a long time to exchange the idea that education is a charity to that of its being a right, a duty, and a safeguard, but it came to that at length. The great public schools of England have a long and honourable history. Eton was established by Henry VI. in 1441; Winchester, by William of Wykeham, 1387; Westminster, prior to the time of Edward the Confessor, but as it now exists by Queen Elizabeth, 1561; Charter-House, by Thomas Sutton, 1611; Harrow, by John Lyon, yeoman, 1571; Rugby, by Lawrence Sheriff, 1567. These are endowed seminaries, in which are combined the characteristics of a boarding-house and a school. Many endowed schools, supported by funds given or lands appropriated to their perpetual use, have equally early dates assigned to their foundation. Harrison in his "Description of England" (1586) states that "there are not many corporate towns now under the queen's dominion that have not one grammar-school." These schools were comprehended under the general legal title of charities (Eliz. c. 43). This indicates that education had no national recognition and provision. Many of these schools are incorporated either by crown letters patent or by Act of Parliament, and so have a legal status. They are generally governed by trustees and regulated by visitors. Prior to the Reformation almost all schools were controlled by and in connection with the church, and most of them were grammar-schools. From the Reformation until the present century endowed grammar-schools supplied a liberal education to those who received their training in them. Dame schools, private seminaries, and boarding establishments, following the law of demand and supply, provided for any other felt need. Many charity schools were founded in 1687; between 1696 and 1741 the Society for Promoting Christian Knowledge founded nearly 2000 schools, and Queen Anne encouraged parochial charity schools and promoted them by her bounty. The educational movements in Germany, France, and Switzerland created a stir, and some anxiety arose to bring the schools of England into higher efficiency, and to spread their usefulness more widely. Early in the present century Owen, Bentham, Brougham, Horner, James Mill, &c., advocated national education. In 1818 (58 Geo. III. c. 19) an "Act for appointing commissioners to inquire concerning charities in England for the education of the poor" was passed. This commission was continued and renewed under several Parliaments. Similar commissions have frequently been appointed. In 1820 a Parish School Bill and a Charities Regulation Bill were introduced by Henry (afterwards Lord) Brougham, but dropped. In 1830 he reintroduced them. Again in 1837 and 1839 he pressed them, greatly altered however, upon the House of Commons. He proposed to establish a system of national education which would not interfere with the voluntary efforts made or likely to be made by corporations or individuals, or in the then existing institutions, endowed or unendowed. "An Act for improving the condition and extending the benefits of grammar-schools" was passed in 1838, and in the same year Parliament appointed a committee of her Majesty's Privy Council to administer a grant made for the promotion of education, which had been first made in 1833. This grant was employed in aiding the *erection* of schools; but in 1846, by a minute of the committee of the Privy Council, it was extended towards the maintenance and the improvement of *teaching* in schools. Government inspection, capitation grants, and a codified system of study shortly followed, and led the way to the acknowledgment by law of the duty and right of every child to be educated.

When the Revolution and the Pestalozzian fervour excited men, various means were adopted to increase the quantity and improve the quality of instruction. Sunday schools were introduced in 1780, and the Sunday School Union was formed in 1802. The Royal Lancastrian Institution for training teachers on Joseph Lancaster's system was founded in 1805. Bell's monitorial system of teaching was promulgated at Madras in 1789, and published in London 1797. The National Society for Promoting the Education of the Poor in the Principles of the Established Church was founded in 1811 and adopted Dr. Bell's methods of teaching. The British and Foreign School Society adopted the nearly similar system of Joseph Lancaster in 1812 and united the dissenters into an active body. Both societies established model schools and training colleges for teachers, and spread through England schools and schoolmasters. Wilderspin and Owen instituted infant schools, and the Home and Colonial Infant School Society developed that system in favour of the church. The Central Society of Education in 1836, under its president, Thomas Wyse, M.P. for Tipperary, was started to provide exact information on education and to impart moral power to the movement for encouraging it. These agencies acting on the government secured attention to the topic; and led to the parliamentary grants being looked on as a recognition of the nation's interest in the proper upbringing of children. The rapid growth of demands on the national exchequer, and the keen interest felt on the subject, made education one of the main controversies of the time. Lord Kerry's report, as it is called, of 1833 had excited great efforts on all sides to lessen ignorance. Both the National and the British and Foreign School Societies redoubled their zeal. They were compelled, after careful inquiry, to confess much deficiency both in quantity and quality. The Voluntary School Society and the Congregationalist Board of Education were founded in 1843, and nearly £200,000 were raised for improving the educational machinery in destitute places. The Ragged School Union in 1846 took up the task of dealing with the extremely poor. Willing-hearted though many were, government was compelled to increase its grants, and succeeded thereby in stimulating interest in the training of the labouring classes. After the publication of the minutes of 1846, under the impression that the plan prescribed therein still left the origination of schools to the chance or caprice of voluntary agencies, the Lancashire Public School Association, on the model of the Anti-Corn-Law League, was formed in 1847, to secure the establishment by law of a system of free schools, supported by the rates, imparting secular education guarded by a conscience clause. The movement was made national in the same year, and a literature of pamphlets was scattered broadcast over the country. Wm. J. Fox brought in a bill in 1850 to effect the objects aimed at, but it failed to secure acceptance, and agitation became intensified. "The education of the people" formed the cry of the day. An Industrial Schools Act was passed in 1857. School ships were established in 1859. But these only excited the desire to know why poverty and crime should not be lessened beforehand by the use of compulsion. At last, anxious to bring agitation to a close, Lord Russell in 1867 proposed a motion in the upper chamber that "every child has a right to instruction, and that it was advisable to appoint a minister of education." The rejection of this

proposal inflamed the country. The compulsory educationists started a league at Birmingham and the denominationalists a union at Manchester in 1869. The Society of Arts brought the chiefs of these bodies together at a conference in 1870, when the main elements of a bill were agreed to. These formed the basis of the Education Act of 1870, brought in and carried by the Right Hon. W. E. Forster. It was a large, liberal, and practical endeavour to bring the education of the country into general effectiveness, on a system at once comprehensive and elastic. It was a compromise. It built upon the old foundations, connecting itself with what was done before. It made use of all the available voluntary efforts of the friends of education, and did not affect their institutions, unless they wished to be brought under the sweep of its enactments. It (1) forms the whole country into school districts—1st, the metropolis; 2nd, the boroughs, except, 3rd, Oxford; 4th, other parishes where voluntary schools are deficient or inefficient—but where education is sufficient, efficient, suitable, and well distributed no school district requires to be formed. (2) Ordains a school board to be elected in each parish where it is needed, and gives directions for the proper election of the same. (3) Requires those school boards which hold office for three years to provide school accommodation and efficient teaching for the children in their districts. (4) Regulates, 1st, the constitution, duties, and proceedings of school boards; 2nd, the appointment of officers and managers by the school boards; 3rd, the payment and remission of fees; 4th, the auditing of accounts; 5th, the purchase of sites; 6th, the taking over of schools. (5) Empowers the use of compulsory measures to secure attendance. (6) Fixes the tenure of the teacher at the discretion of the board, and arranges for his removal when necessary. (7) Puts the power of assessing a rate in the hands of the school board, and the responsibility of accounting for the same to the localities as well as to the department. (8) Provides for—1st, the inspection of schools; 2nd, the administration of grants; 3rd, the use of small endowments and charitable trusts; and 4th, the requiring and receiving of full information on such points as the department may from time to time desire. (9) Enforces the laying of an annual report before Parliament by the department of their proceedings under the Act. (10) The metropolis is made the subject of special arrangements as to—1st, the constitution, divisions, and boundaries of its districts; 2nd, the number of members of board to be elected; 3rd, the order and mode of their election; 4th, their borrowing powers. (11) The conditions on which grants in aid of public education are given to managers of schools are laid down as—1st, the proficiency of the scholars; 2nd, their attendance; 3rd, the observance of the conscience clause; 4th, that the schools are used for the education of the classes who support themselves by manual labour. Of the more important clauses the following relate to—I., the local provision for schools, their supply, management, and maintenance, 4–28; II., the constitution of school boards, 29–52; III., the school fund and finance, 53–62; IV., the mode of dealing with defaulting boards, 63–66; V., the returns to be made and the information to be given, 95 and 67–72; VI., the procedure at public inquiries, 73; VII., the attendance at school, 74; VIII., the administration of the parliamentary grants, 96–100; IX., the tenure of office, 96; X., the ratepayers' right to inspect the books of the board, 87. An amended Act was added, to be construed with this, in 1873. It, I., provides for the payment of fees for poor children, 3 and 4; II., regulates elections, 5–9; and III., makes miscellaneous changes as regards—1st, loans, 10; 2nd, union of detached parts of parishes, 11 and 12; 3rd, acceptance of gifts for education, 18; 4th, the issue of notices, 20; 5th, making returns, 22, and examination of accounts, 17; 6th, legal proceedings, 23–25. The Act of 1876, which makes further provision for elementary education, (1) declares that it is the duty of parents (or guardians) to educate each child; (2) regulates employment, which is not to be undertaken at an age less than ten, nor without (*a*) certificate of proficiency, or (*b*) as half time, even then under penalty, 5–9, 11–13, 37–39; (3) permits and arranges for industrial school attendance, 14–17; (4) allows fees for poor clever children to be paid out of parliamentary grant; (5) requires certificates of attendance and proficiency, 21–23; and (6) makes administrative provisions for the carrying out of the purposes of the Act, 24–36, and miscellaneous arrangements for the same end.

Scotland.—The parochial school system of Scotland was a survival of Catholic ecclesiasticism. Many excellent burgh grammar-schools existed from a very early date besides the church schools. Education was early cared for by the state. In 1494 the principles of taxation for educational objects and compulsory attendance were adopted. Parliament then enacted "that all barons and substantial freeholders throughout the realm should send their children to school from the age of six to nine years, and then to other seminaries to be instructed in the laws, that the country might be possessed of persons properly qualified to discharge the duties of sheriff and to fill other civil offices." A penalty of £20 Scots was exacted from offenders. In 1615 the Privy Council ordained the bishops and heritors to establish a school in each parish, and assess the land for its support. Parliament confirmed that Act in 1633. The providing of a school-house and of a salary for the teacher was made compulsory on the heritors in 1696, and if they failed the presbytery was bound to see this done at the heritors' expense. This school was intended to be the chief and model one, but it was expected that others would be provided on the same principle. This was not done, though occasionally side schools were set up by endowment, subscription, or individual charity. The Society for the Propagation of Christian Knowledge in 1704 directed their attention to the scattered, insular, or intersected parishes, and in 1735 provided missionary catechists and teachers for the highlands and islands. In 1794 a committee of the General Assembly of the Church of Scotland sent a deputation of inspection through needful localities, and education in Gaelic and English was increased. Having found the labours of the parish schoolmaster of "essential importance to the public welfare," and "the provision made in the previous Act altogether inadequate for a body of men whose labours are of so great public utility," the salaries payable were raised in 1803, and a commodious house and garden were to be provided. Every twenty-five years thereafter the salary was to be regulated by the price of corn. Owing to the population having increased, and being gathered into large centres of industry, the parishes were in some cases almost depleted and in others overgorged. There was therefore an Act passed in 1838 "to facilitate the foundation and endowment of additional schools" by sums voted by Parliament for these purposes. In 1861 the religious test, obligatory on schoolmasters, was amended, the mode of appointment changed, and the tenure of their office altered, while their income was raised. This was the only one of five bills introduced into Parliament between 1854 and 1872 which passed. When in 1870 the English Elementary Education Act became law, Scotland expected that on its statute-book an amended Act would be placed. A bill for that purpose was introduced, but from pressure of public affairs it failed to pass into law. In 1872—the tercentenary of the death of John Knox—the new Education Act of Scotland, the object of which was to furnish and make available to the whole people of Scotland the means of procuring efficient education, became the law of the land. It (1) created a Scotch Education Department of the Privy Council to administer the imperial grants, and to determine upon and regulate the

instructions to be given in schools; (2) established a popularly elected school board—consisting of from five to fifteen members—in every parish and burgh, whose duties are—1st, to manage all rate-supported schools within their district; 2nd, to see that the school accommodation is adequate; 3rd, to provide and maintain efficient education for all; 4th, to enforce the procuring of suitable teaching by all; 5th, to impose rates for the purposes of the Act; 6th, to take charge of certain higher class schools; 7th, to receive and administer income and property properly applicable to school teaching; and 8th, to superintend the schools, teachers, funds, education, and school trusts of their districts—so far as they fall under the Act. (3) Gave sanction to religious teaching in schools, so arranged as, 1st, not to interrupt or interfere with secular instruction; and 2nd, that children may be withdrawn from receiving it without loss of any of the other advantages of the school. That the new system, which was to be more elastic yet more binding than the former parochial plan, might get readily into working order a Board of Education was appointed for three years, and then it lapsed. The Act may be summarized under the following heads, the numerical references denoting the clauses in which the information is given:—I. The constitution of school districts, 1, 8–11, 17; II., the management, 3–5, 8, 12–22, 48, 52, 57, 58, 67, 70; III., the school accommodation, its supply and maintenance, 23–42; IV., finance and parliamentary grant, 43–53, 67, 70, 78; V., teachers, 54–61, 76–78; VI., higher class schools, 62–64; VII., miscellaneous provisions—1st, compulsory attendance, 69–73; 2nd, conscience clause, 68; 3rd, inspection, 66; 4th, Acts repealed, 78; 5th, definitions, 1; 6th, reports, 74, 75; 7th, exceptions and exemptions, 12, 73, 79.

The foregoing Act was amended in an Act to be construed as one with it in 1878, which *inter alia* enacts (1) that no child under ten, or any child between ten and fourteen years of age (unless having a certificate or attending school as a half-timer) shall be taken into employment; (2) restricts the age and hours of casual employment permitted: the Act is to be enforced against parents, employers, &c., by school-board officers, factory inspectors, &c.; (3) arranges for vacancies in school boards by resignation or death, and by disqualification for non-attendance and for holding office under the board; (4) regulates the examination of higher class schools, (5) provides for the franchise of teachers, (6) allows union of school boards, (7) empowers compulsory purchase of sites, (8) gives teachers a right to petition "the department," and (9) orders the parochial board to pay over the school-rate without charging for levying and collecting it. In 1882 the Public School Teachers Act provided (1) that three weeks' notice of a motion for dismissal of a teacher should be given to the board and the teacher; and (2) that no resolution for dismissal should be valid unless passed by an actual majority of the whole members. (3) Suspension is permitted. An Act to reorganize the educational endowments of Scotland and increase their usefulness to boys and girls of promise was passed in 1882, under which a commission was appointed to have power to prepare drafts or schemes for the future government and management of educational endowments, with special regard to higher or technical education. The Education Act 1883 renders attendance in school compulsory till fourteen, except when employed half time or having passed the fifth standard.

Ireland.—Education flourished in Ireland during the middle ages. The Celtic monasteries were centres of light. Their members devoted themselves to prayer, study, and the transcription of MSS. or the compilation of books. Missionary zeal excited eagerness for knowledge. Not only did the monks carry learning abroad, as St. Columban did; but scholars from every land and English students of all classes found hospitable welcome, food, books, and instruction in the schools of the saints. Aldhelm (656–709) tells us that "troops of students" were "daily transported" to Irish seminaries of "unspeakable excellence," and says that "Erin, rich and blooming in scholars, is adorned like the poles of the world, with innumerable bright stars." After the long wars ending in its conquest, learning somewhat lost its vantage ground. The earliest act of English legislation touching Irish education was that of 28 Henry VIII. It was designed to make "the English order, habit, and language the wont of Ireland." Every incumbent was bound to set up and maintain an English school in his parish. Elizabeth in the twelfth year of her reign ordered every clergyman to "endeavour himself to learn, instruct and teach the English tongue to all and every one under his rule." These enactments were renewed by 7 Will. III. c. 4; while by 8 George III. c. 12 bishops and rectors were empowered to grant, the former two acres, the latter one, to a resident Protestant teacher. No other schoolmasters were permitted. It was a transportable offence for a Roman Catholic to act as tutor or teacher, and it was criminal to send children out of the country to be educated. These Acts were only repealed in 1778. All this while the Irish hedge schools, with their numerous learned, quaint, and popular itinerant teachers, supplied an education which to many, if not so systematic, was more agreeable than that obtained in the school-houses permitted by law. Besides the parochial and diocesan schools, Charles I. in 1627 endowed several royal schools. Erasmus Smith's schools were founded in 1669, for the training of children of all denominations. Charter schools for Roman Catholics who changed their name, forgot their parents, and abjured their religion were established in 1735. Howard the philanthropist visited many of them in 1784 and 1787, and his evidence led to an investigation. In 1808 a commission reported against them, and in 1824 steps were taken for their suppression. The Association for Discountenancing Vice and Promoting the Knowledge of the Christian Religion was founded in 1792, and instituted many schools for the poor. The London Hibernian Society, established in 1806, also set up schools for children of all denominations. The Kildare Place Society, founded in 1811, erected model schools on a combined plan, containing elements selected from Pestalozzi, Bell, and Lancaster, together with arrangements for Bible reading, but no doctrinal teaching. The Baptist Irish Society did good work, too, in diffusing knowledge and moral training among the people, but neither public nor Parliament was inspired with confidence. A new organization, under the sanction of the legislature and with the responsibilities of a public body, was suggested in 1824, and continued to excite discussion till 1830. The disfavour into which all sectarian endeavours to promote education had fallen induced Mr. Stanley (then chief secretary of state for Ireland and afterwards fourteenth Earl of Derby) to make a new but less sectarian attempt. He moved for and succeeded in obtaining, September, 1831, a sum of £30,000 to be applied for educational purposes in Ireland. Thus the celebrated Irish national system of education was set on foot. It gave a distinct state organization to schools for the people. The management of this fund was put in charge of a board, afterwards, in 1844, incorporated as the Commissioners of National Education in Ireland. The Rev. James Carlile, a Presbyterian clergyman, took the most active part in arranging the machinery and working the system. Of this mixed education, suddenly brought upon them, all parties were at first jealous. When, however, Dr. Whately became archbishop of Dublin, and Dr. Murray, the Roman Catholic archbishop, consented to co-operate in carrying out the scheme, great success attended it. The school books were prepared under the supervision of the board, and were only adopted when the commissioners were unanimous. The management proved itself effective, and for twenty-one years all went on harmoniously. About 1853, a different spirit showed itself,

Whately withdrew, and much dissatisfaction was expressed. The Church of England Education Society was founded in 1864 to carry out the dissent of the Protestants; but this system still remains in operation. The introduction of the Intermediate Education Act in 1878 completes the gradation of schools in Ireland, from the country village seminary to the seats of learning in the universities.

It remains now only to be noticed that the interest roused in teaching led the schoolmasters to consider themselves entitled to professional recognition. This was claimed by the Educational Institute, and an incorporating charter was granted to it. The College of Preceptors in England also secured a charter. Both of these, being formed for the promotion of sound learning, provided courses of lectures on education, and required proof by examination of the possession of knowledge. It had been proposed in 1828 by Professor Pillans to found lectureships on didactics in the Scottish universities, and this idea of having education made a university subject was pressed by these bodies. The establishment of normal colleges for a while interfered with the practical accomplishment of this design. In 1851 endeavours were made to formulate the plan of a professorship. Various means were used to accomplish this aim. Mr. Joseph Payne, under the auspices of the College of Preceptors, in 1873 commenced lectures on the science and art of education, and these have been continued by successors. In 1876 the trustees of Dr. Bell's (Madras) fund endowed, in Edinburgh and St. Andrews, chairs of education. Cambridge instituted a "teachers' training syndicate," and provided lectures, examinations, and diplomas; London University now grants teachers' diplomas, and Oxford has settled a scheme of training for teachers. A training college for teachers of higher class schools has been established at Finsbury, and the education department now requires from all its certificated teachers some knowledge of the history, theory, and practice of education. The Education Society, for examining and expounding the principles of education, was founded in 1875, and the Ascham Society, for promoting the interests and progress of learning and educationists, in 1880. The National Union of Elementary Teachers in England is now an influential body, as is the Teachers' Union in Ireland. The Teachers' Guild of Great Britain and Ireland has been founded (1884) to facilitate a closer co-operation among teachers, and with those who are interested in educational effort and progress. The services rendered by the Social Science Association to the cause of education have been considerable in bringing and keeping before the public mind that education is a *science* of (1) observations, (2) experiment, (3) reported results, (4) theories based on these; and an *art* of (1) results made in dependence on theory, and (2) means intentionally applied to the production of a fixed purpose—the wisely regulated exercise and development of the whole nature of man.

EDWARD THE CONFESSOR, King of England, was the eldest of the two sons of Ethelred II. by his wife Emma, the daughter of Richard I. (the Fearless), duke of Normandy. He was born at Islip, in Oxfordshire, probably in the year 1004. At the close of 1013, when the successes of Swegen the Dane drove Ethelred from his throne, and compelled him to retire to the Isle of Wight, he sent over his wife, with Edward and his younger brother Alfred, to Normandy, to the care of their uncle, Duke Richard II. (the Good). Edward spent the greater part of his time in Normandy, till 1035, occupied chiefly in the offices of religion and in hunting. Canute had married Edward's mother, Emma, in 1017; she had borne him one son, Harthacnut, to whom she vainly endeavoured to secure the succession on Canute's death in 1035. Edward then made a slight demonstration in favour of his own rights, but soon returned to Normandy. In 1036 his younger brother Alfred proceeded to England at the head of another expedition, which terminated in his assassination by the servants of King Harold I. There does not seem to be sufficient ground for the horrid suspicion, frequently expressed, that the contriver of the plot was his own mother. When Harthacnut succeeded his half-brother Harold (also son of Canute, but by a former wife), he sent for his half-brother Edward, to whom he allowed a handsome establishment, and who appears to have been considered as the heir to the crown in default of issue of the reigning king. Harthacnut died, June, 1042, and Edward was immediately recognized as king by the assembled body of clerical and lay nobility. Edward the Outlaw, son of Edmund Ironside, was away in Hungary.

In 1044 Edward, probably in compliance with a promise which he had made to Earl Godwin, married Edith, the only daughter of that earl, having previously informed her, however, that although he would make her his queen she should not share his bed. This unnatural proceeding arose from perverted religious motives; he seems to have been without human affections of any kind, and to have aimed at the narrowest monkish ideal. His first act, after coming to the throne, was to proceed to the residence of his mother, Queen Emma, at Winchester, and he not only seized by force all her property, but, as is stated, endeavoured to destroy her by an accusation from which she freed herself by the ordeal.

The public events that form the history of the reign of the Confessor resolve themselves for the most part into a contest between two great parties or interests which divided the court and the country. Edward had spent in Normandy all his life from his childhood; his tastes and habits had been formed in that country, and all his oldest personal friends were consequently Normans. But while the inclinations of Edward were probably from the first with the Normans, he was to a great extent in the hands of the opposite or English party, from his connection with Earl Godwin, its head. It was not, however, till the year 1051 that the strength of the English and Norman parties was tried in any direct encounter; but that year a broil arose out of the visit to England of Edward's brother-in-law, Eustace, count of Boulogne. The first effect was the banishment of all the Godwin family, and the degradation and imprisonment of Queen Edith, and the second the overrunning of the land by a horde of Normans fawning on the half-Norman king. The young Duke William of Normandy, only twenty-three years old as yet, came over and stayed with Edward, making his first acquaintance with the land he was afterwards to conquer and rule. The following summer Godwin and his son Harold forced their way back to the country. The queen was re-established in her possessions and her place, and the Normans were all expelled from the kingdom. Among others Robert, the much-hated archbishop of Canterbury, fled before the popular execration. Stigand was made archbishop in his stead. But as Robert had never been deposed by the pope, it was long before Stigand could get the consecrated scarf of office (*pallium*), and when Harold extorted it from Pope Benedict Stigand was not much better off, as Benedict's own election (to the Papacy) was disputed. See EALDRED.

Earl Godwin only survived this counter-revolution a few months; he died suddenly as he sat at the royal table, on the 15th of April, 1053. Godwin's son Harold inherited his possessions and his power, and the ascendency of the family under its new head continued as great as ever during the remainder of the Confessor's reign. Edward died on the 5th January, 1066, and was buried the following day in the new Abbey of Westminister, which had been finished and consecrated with great pomp about a week before. On the same day Earl Harold was solemnly crowned King of England. Edward the Outlaw had been brought over from Hungary in 1057, but died on reaching England. His son, Edgar the Atheling, was quite young,

and besides practically a foreigner. The witan, therefore, abandoning the old royal house of Cerdic, chose Harold Godwinson to be king. See HAROLD II.

Edward the Confessor was canonized by Pope Alexander III. about a century after his death, and the title of the Confessor was first bestowed upon him in the bull of canonization. It may also be mentioned that the use of the Great Seal was first introduced in this reign.

EDWARD THE ELDER (*Eadward*, pronounced nearly as "Yadvard"), King of the West Saxons, was the eldest son of Alfred the Great by his queen Alswitha (*Ealhswyth*). On the death of his father, 26th October, 901, Edward was recognized by the witenagemote as his successor; but the throne was contested by his cousin Ethelwald, son of King Ethelred (*Æthelred*), elder brother of Alfred. Edward quickly put an end to Ethelwald's rebellion; but the defeated prince fled to the north, and was chosen to be king by the Danes of Northumbria. He then descended on Essex with his new subjects, continued to incite the Danes of East Anglia to enter Mercia, and kept the kingdom in a state of perpetual unrest, till the contest was terminated, in 906 or 907, by the death of Ethelwald in a battle fought between his forces and those of Edward. East Anglia and the Northumbrian Danes next submitted to Edward, and Mercia, which had been well governed by his sister Ethelfleda (*Æthelflæd*), also came under his government on her death in 920. After this the Welsh, the people of Strathclyde, and the King of the Scots and all his subjects, also chose the English monarch as their lord, so that Edward the Elder was the first king of the West Saxons who was truly lord of all Britain. He alone was king—other princes were his subjects. After Edward all our kings are "kings of the Anglo-Saxons," or more usually "kings of the English," nevermore, as before they had been, "kings of Wessex." It was in Edward's reign that occurred the foundation of Normandy in 913 by Rolf the Gangr.

Some of the laws of Edward the Elder are preserved, but they do not require any particular notice. He died in 925, and was succeeded by his eldest son Athelstan, whose mother was Egwina (*Ecgwyn*), who also bore Edward another son and a daughter. By another wife, whose name is unknown, he had two sons and six daughters; and by a third wife, Edgiva (*Eadgifu*), he had two sons—Edmund and Edred, both of whom were afterwards kings of England—and two daughters. Of the eight daughters of Edward the Elder, three became nuns and the rest queens. This is worthy of notice as showing the large amount of power and consideration he enjoyed. Edgiva married Charles the Simple, king of France; and upon his deposition by Count Robert of Paris she and her son Louis, afterwards king (hence called Louis d'Outremer, "Louis from beyond seas"), took refuge with Edward till better times. (Robert meanwhile became king of France for a short time, and fell in a battle with Charles.) Another married Otto, king of the East Franks, afterwards emperor; another married Hugh the Great, duke of the French, son of the King Robert mentioned above, and virtual ruler of France; another was queen of Provence, and another queen of Northumbria.

EDWARD THE MARTYR, King of England, was the eldest son of Edgar, on whose death in 975 the accession of Edward was opposed by a faction headed by his stepmother Elfrida (*Ælfthryth*) in favour of her own son Ethelred (*Æthelred*). Edward was supported by Dunstan, and was, after much opposition, formally accepted as king by the witenagemote. Elfrida, however, still continued her intrigues, and caused Edward to be stabbed while drinking his stirrup-cup at the gate of Corfe Castle, 978. Edward was only seventeen at the time of his death, and as he left no children Ethelred (the Unready) succeeded to the throne.

EDWARD I., King of England, surnamed *Longshanks*, often called Edward the Great, was the eldest son of Henry III. by his wife Eleanor, second daughter of Raymond, count of Provence. He was born at Westminster, 16th June, 1239. In 1253, to reconcile a disputed claim to the duchy of Guienne, Edward was married to Eleanor, the sister of Alfonso X. of Castile, who thereupon resigned whatever right he had to the duchy to his brother-in-law. After this, in 1254, we find the lordship of Ireland, and all the Norman provinces which had been seized from King John by the King of France, granted to Edward by Henry III.

Edward early manifested a character very unlike that of his weak and imprudent father, and even from his youth we find him taking part in important affairs of state. In 1263, during the quarrel between Henry and his barons, the military operations on the king's side were principally conducted by Prince Edward. Though at first unsuccessful, and even taken prisoner with his father at the battle of Lewes, fought 14th May, 1264, he defeated and slew the great Earl of Leicester (Simon de Montfort) at Evesham in 1265, and finally succeeded in re-establishing his father's authority. Possibly to free the land from the bands of discontented soldiery which hung about on every side, in 1269 Prince Edward, with numerous followers, set out to join the crusaders in the Holy Land, where he arrived in May, 1271. He distinguished himself on many occasions, and received a wound in the arm from a poisoned dagger, from the effects of which he is said to have been delivered by the princess, his wife, who sucked the poison from the wound. At last having concluded a ten years' truce with the Saracens, he left Palestine in August, 1272, and set out on his return to England. While on his way his father died, and after his arrival in England with his queen they were crowned at Westminster, 19th August, 1274. It is noticeable that Edward I. was the first king since the Conquest who bore an English and not a Norman name; this certainly was not without weight in his consolidation of the hitherto divided nation.

The first military operations of Edward's reign were directed against the turbulent Welsh, who refused to recognize the English supremacy. In a brief campaign in 1277 they were brought to terms, and for four years remained quiet. Prince Llewellyn then rose in rebellion, and Edward had to reconquer the country after a hard struggle, 1282. Llewellyn died in a petty skirmish. The alleged massacre of the Welsh bards by Edward is a complete fiction. By the Statute of Wales the country was divided into the well-known twelve shires on the English model, and the native barbarous customs abolished. Wales remained in perfect peace for a century.

The conquest of Wales was followed by that of Scotland. The general course of events and the issue will be found under BALLIOL, WALLACE, and BRUCE. During a part of the time occupied by this contest, Edward was also involved in a war with Philip IV. of France, with whom he concluded a truce in 1297. The expenses of his Scottish and French wars had pressed heavily upon the resources of the kingdom; and when he asked for more money both clergy and laity refused him any further grant without a redress of grievances and a confirmation of the several great national charters. After standing out for some time, he was obliged to comply with these terms. Magna Charta and the Charter of Forests were both confirmed, with some additional articles, in a Parliament held at Westminster in October, 1297.

While marching against Scotland, which had again risen under Robert Bruce, after having been twice conquered by Edward (once when under Balliol, and again when under Wallace) Edward died at Burgh-on-the-Sands, 7th July, 1307. On his deathbed he is said to have enjoined his son and successor to prosecute the design which it was not

given to himself to finish. According to Froissart, he made him swear that after the breath had departed from the royal body he would cause it to be boiled in a cauldron till the flesh fell off, and that he would preserve the bones to carry with him against the Scots as often as they should rebel. The corpse instead was interred in Westminster Abbey on the 28th October.

Edward I. was twice married. By his first wife Eleanor, daughter of Ferdinand III., king of Castile and Leon, he had four sons, three of whom died young; the other, Edward, succeeded him. He had also by Eleanor nine daughters. Queen Eleanor died in 1291, at Grantham, in Lincolnshire; her body was brought to Westminster to be interred, and crosses were afterwards erected on the several spots where it rested on the way, of which those of Northampton and Waltham still exist. Charing Cross was one of these stations (*chère reine*, beloved queen, is said to be the origin of the word *Charing*). Edward's second wife was Margaret, eldest daughter of Philip III., and sister of Philip IV., kings of France.

Edward I. was eminently possessed of activity, decision, military skill, and political foresight. As regards Scotland his great mistake lay in forcing on what could only prove beneficial when it was the result of voluntary agreement. Though engaged during nearly the whole of his reign in war, he paid great attention to the civil government of his kingdom. More was done in the first thirteen years of his reign to settle and establish the distributive justice of the kingdom than in all the next four centuries. The confirmation and final establishment of the two great charters, the definition and limitation of the bounds of ecclesiastical jurisdiction, the ascertainment and distribution of the powers and functions both of the supreme and the inferior courts, the abolition of the practice of issuing royal mandates in private causes, and many reforms of legal proceedings, took place. Among them was the establishment of the equitable jurisdiction of the chancellor, which soon took form in the Court of Chancery. Another famous court which took origin under the English Justinian was the court of the "king in council," which steadily maintained its authority against the equally steady jealousy of the Parliament, until it reached its final statutory form in the court of STAR CHAMBER under Henry VII. Its functions still exist and are fulfilled by the judicial committee of the Privy Council. Under Edward I., also, the foundations of the constitution of the kingdom may be considered to have been laid by the new form and the new powers which were then assumed by the Parliament. The earliest writs that have been preserved for summoning knights, citizens, and burgesses to Parliament are, as is well known, those that were issued by Simon de Montfort, earl of Leicester, the leader of the barons, in 1265, in the name of King Henry III., who was then a prisoner in his hands. The division of the legislature into two houses, in other words the institution of our present House of Commons, appears likewise to be clearly traceable to the time of Edward I. Edward's division in fact was into *three* houses, and is commemorated in our expression, "the three estates," namely, the Lords Spiritual, the Lords Temporal, and the Commons. For purposes of taxation the whole of the clergy were summoned by their lords and their proctors; but they steadily refused to sit with the laity or to work at all except among themselves; and as they only came under stringent compulsion, the summons to them was allowed to fall into a mere formality. It is certainly a happy thing for the country that the clergy so obstinately flung away their power to become a majority in the House of Lords. With Edward the Great, then, Modern England begins. His Parliaments and his laws are ours. One of his statutes, if unrepealed, is as valid in our courts as one of Victoria. England then took its present form, and has never since radically changed, in all her long and continuous development.

EDWARD II., the eldest surviving son of Edward I., was born at Carnarvon, 25th April, 1284, and proclaimed the first English Prince of Wales. Since that time the heir-apparent to the throne has usually born this title. Though occasionally accompanying his father in his expeditions, and sharing the remarkable capacity possessed by all the Plantagenets, Prince Edward very early began to form those vicious associations which were the chief source of the calamities of his life. Gaveston, his first favourite, was banished by the king in 1297, and again in 1307. Edward II. was immediately recognized as king on the death of his father. The new king obeyed his father's injunctions and continued the Scottish war, at first with some success, but afterwards, when Edward's troubles with his barons began, with weakness enough to enable Bruce first to take Stirling and then to win Bannockburn over Edward in person, 1314. The struggle still continued until it was brought to an end in 1323 by a truce for thirteen years. In the meantime Edward recalled Gaveston, created him Earl of Cornwall, married him to his niece, and bestowed estates on him with reckless prodigality. Finally, he left him guardian of the realm while he set out for Boulogne in 1308 to marry Isabella, the daughter of the French king, Philip V.

The history of the kingdom for the next few years is merely that of a long struggle between the king and his nobility about this Gaveston. Edward's attempt to avoid the coercion of the great lords was resented by the appointment by Parliament of "lords ordainers," long resisted by Edward, and indeed not finally submitted to by him till 1318. As for Gaveston he was banished, recalled, and again banished, and again brought back, till he was at length taken in Scarborough Castle by the barons, and executed summarily near Warwick, 1312.

A new favourite soon afterwards began to engross Edward, Hugh le Despenser. Upon him the king now bestowed in marriage another daughter of his sister, the Countess of Gloucester, with large possessions. Another armed insurrection of the barons was the consequence. Despenser and his father were banished, but they returned, and with the king succeeded in defeating the barons, many of whom, and among them the Earl of Lancaster, were executed, and their estates given to the younger Despenser, 1321. At this time Charles IV. of France, having seized Guienne and other territories of Edward's in France, Queen Isabella was sent to negotiate with her brother; but while at his court she joined the party of exiled English barons she found there, at the head of which was Roger de Mortimer. There is no doubt that the connection between Queen Isabella and Mortimer became eventually a criminal one. The queen landed at Orwell, in Suffolk, 22nd September, 1326. She was immediately joined by all the most distinguished persons in the kingdom, including even the Earl of Kent, the king's half-brother. The Despensers were taken and executed. The king was imprisoned, first in Kenilworth, where he was formally deposed, and then successively in Corfe, Bristol, and Berkeley Castles, and was at length murdered at the latter place on 20th September, 1327, by his keepers. Gloucester alone consented to give him burial.

Edward II. left by his queen, Isabella of France, two sons—Edward, who succeeded him, and John—and two daughters, one of whom, Joanna, was married, 12th July, 1328, to Prince David, eldest son of Robert Bruce, afterwards King David II. of Scotland.

To the reign of Edward II. belongs the memorable event of the suppression in England, as in the other countries of Europe, of the great order of the Knights-templars.

EDWARD III., King of England, the eldest son of Edward II. and Isabella of France, was born at Windsor, 13th November, 1312. In 1325 he went to his mother in France, returned with her to England in September, 1326, was declared guardian or regent of the kingdom

about a month afterwards, and was proclaimed king on the deposition of his father, 25th January, 1327.

The government of the kingdom during the king's minority was placed by Parliament in the hands of a regency, but the queen-mother and her lover Roger Mortimer (now created Earl of March) from the first assumed the chief management of affairs, monopolized all the power, and must be considered as having been the real authors of the murder of the deposed king.

Shortly after Edward III.'s accession Mortimer declared war against Robert Bruce, king of Scotland, which was terminated by a peace in March, 1328, providing that David the son of Bruce should marry Joanna the sister of Edward; and this settled the dispute between the two countries for the time being. Towards the close of the year 1330 Edward determined to make a bold effort to throw off the government of Mortimer, and succeeded. Mortimer was executed, and Isabella was placed in confinement in her house at Risings (where she was detained for the remaining twenty-seven years of her life), and the king took the government into his own hands. In the course of the following year Edward seems to have formed the design of resuming the grand project of his father and his grandfather—the cónquest of Scotland, for this purpose he made a tool of Edward Balliol, son of King John Balliol. He furnished him with the means of invading Scotland, in which the unexpectedness of the attempt gave him some success, and he was crowned at Scone. He then acknowledged Edward III. as his liege lord at Roxburgh, in November, 1332, but was in consequence almost immediately afterwards driven out of Scotland. Edward then advanced with an English army, defeated the Scottish regent, Douglas, at Halidon Hill, on 19th July, 1332, and restored Edward Balliol. The nation, however, would not submit. Several devastating campaigns, varied by occasional truces, produced no permanent effect.

From 1336, however, his attention was somewhat withdrawn from Scotland, in order to prosecute the claim he had set up to the crown of France—the cause of the long and bitter Hundred Years' War between the two nations. The claim of Edward is described in the article Custom. Edward embarked for the Continent on the 16th July, 1338, and assumed the title of King of France. The first important action that took place was the sea-fight off Sluys, on the 22nd June, 1340, in which the English were completely victorious. It was followed by long truces, which protracted the contest without any decisive events. While prosecuting the war in 1346, Edward had taken with him his son the Black Prince (born in 1330), and in the victorious battle of Crécy the main division of the English army was commanded by the prince. Among those who fell was John of Luxemburg, king of Bohemia, whose armorial ensign of three ostrich feathers and the motto *Ich Dien* (I serve) the Black Prince assumed, and transmitted the badge to all succeeding princes of Wales.

The defeat of the French at Crécy was followed, on 17th October in the same year, by the equally signal defeat of the Scots at the battle of Neville's Cross, near Durham, in which the greater part of the nobility of Scotland were either captured or slain, and King David II. of Scotland himself, after being wounded, was made prisoner.

Three days after the battle of Crécy, Edward sat down before the town of Calais. It surrendered after a defence of nearly eleven months, and the English king was prevented, by the intercession of Queen Philippa, from making his name infamous for ever by taking the lives of the six burgesses given up to him as the price for which he consented to spare their fellow-citizens. The reduction of Calais was followed by a truce with France, which lasted till 1355. When the war was renewed, Philip IV. had been dead for five years, and the throne was occupied by his son John II. On the 19th of September, 1356, the Black Prince gained the battle of Poitiers, at which the French king was taken prisoner. The kings both of France and Scotland were now in Edward's hands, but neither country was yet subjugated. At last, after many negotiations, David II. of Scotland was released in November, 1357, from his eleven years' captivity for a ransom of £100,000, to be discharged in ten yearly payments. King John II. of France was released on his parole in 1360, but returned to London on finding that he could not comply with the conditions on which he had received his liberty, and died there 8th April, 1364. By the treaty of Bretigny (1360) Edward, whose army was totally exhausted, gave up his claims on the duchy of Normandy and the crown of France, but was recognized as sovereign (not as feudal lord merely) of Aquitaine, Guienne, and Gascony.

King David of Scotland had probably only obtained his liberty by a secret agreement to promote the views of Edward on the independence of his country, for on the death of his wife Joanna, without issue, in 1362, he proposed to the Parliament of Scotland the adoption of Lionel, duke of Clarence, third son of Edward, as his successor. This was unanimously rejected.

In the meantime affairs in France went on badly. The French hero Du Guesclin drove the English everywhere before him. In the summer of 1372 two expeditions were fitted out from England, the first commanded by the Earl of Pembroke, the second by King Edward in person, accompanied by the Black Prince, but both completely failed. At last, in 1374, when he had lost everything that had been secured to him by the treaty of Bretigny, Edward was glad to conclude a truce for three years.

Thus ended the French wars of this king, which had cost England so much blood and treasure. Those which he waged against Scotland equally failed of their object. David II. had died in February, 1371, and was succeeded without opposition by Robert II., the first king of the house of Stuart.

The latter years of Edward's long reign presented in all respects a melancholy contrast to its brilliant commencement. The Black Prince died in his forty-sixth year (1376), leaving one son, Richard, a child in his tenth year. King Edward, in the weakness of his old age, had now for some time given up the entire management of affairs to his second son, the unpopular Duke of Lancaster. Since the death of his queen also he had attached himself with doting fondness to Alice Perrers, one of the ladies of her bedchamber, and had excited great public disgust by the excesses to which this folly carried him. The last fortnight of his life he spent at his manor at Shene, now Richmond, attended only by this woman. But even she, tearing the rings from his numbed fingers, deserted him on the morning of his death; and no one save a single priest was by his bedside, or even in the house, when he breathed his last, on 21st June, 1377, in the sixty-fifth year of his age and the fifty-first of his reign.

Edward III. had by his queen, Philippa of Hainault, seven sons and five daughters. He was succeeded by his grandson Richard II. In this reign began the legislation respecting the poor, by the enactment of the Statute of Labourers (1350), which was followed by several other Acts of the same kind, setting a price upon labour as well as upon provisions.

EDWARD IV., King of England, was the eldest son of Richard, duke of York, who claimed to be heir to the crown in preference to Henry VI. Richard of York descended, by his mother, Anne Mortimer, from Lionel, duke of Clarence, the third son of Edward III., while Henry VI. descended from John of Gaunt, duke of Lancaster, the fourth son of Edward III.

Richard, duke of York, the son of Richard, earl of Cambridge, and of Anne Mortimer, first makes his appearance in public affairs in the end of the year 1435, as regent of

France. The dominion of France was then fast passing out of the hands of the English. On 29th April, 1441, his son Edward, earl of March, afterwards Edward IV., was born at Rouen. The Duke of York was recalled in 1447 through the influence of the queen, Margaret of Anjou, a high-spirited woman, ambitious of governing in the name of her weak husband. Before this the unpopular government of the queen and the Duke of Suffolk, her favourite, had turned men's minds to the claims of the Duke of York; and he had already in all probability formed the design of securing the crown for himself and his family. The king had been married for several years without having any children, and it appears to have been generally expected that the duke, by merely waiting for his death, would obtain the crown without any risk or trouble. On the birth of the Prince of Wales, however, in October, 1453, it became necessary to adopt another course. After some parliamentary contentions both parties collected their forces to decide their quarrel by the sword. The civil Wars of the Roses then commenced, Richard of York adopting the white rose as his emblem, Henry VI. the red rose. Battles were fought with varying success, and Parliaments were summoned to carry out the views of the dominant party, whichever it might be. The Duke of York, however, at first only aspired to be regent, and made no claim to the crown until after the battle of Northampton, in June, 1460. A Parliament was summoned at Westminster, and the duke delivered a written claim to the crown. It was determined that Henry should remain king during his life, but that the Duke of York should be declared his successor. Queen Margaret in the meantime had collected her forces in the north, whither the Duke of York repaired to give her battle himself, but was defeated and slain at Wakefield, on 31st December. Edward, now duke of York, was at Gloucester when he heard of this disaster. He first routed a considerable royal force, under the Earls of Ormond and Pembroke, at Mortimer's Cross, near Hereford, on 2nd February, 1461, and then set out for London, while the queen, though she had defeated the Earl of Warwick on 17th February at St. Albans, and regained possession of the king's person, retired to the north. Edward entered London on the 28th, and claimed the crown on 2nd March before an assembly of lay and clerical lords and an assembly of the people. His nomination as king was received with acclamations of assent, and 4th March, 1461, was considered as the day of his accession.

The first three years of the reign of Edward IV. were occupied by a prolongation of the contest that raged when he mounted the throne. The Lancastrians were defeated at Towton in Yorkshire, on 29th March, 1461, and Queen Margaret's army was routed and dispersed at Hexham, on 17th May, 1464. This victory, and the capture of Henry a few days afterwards, put an end to the war. In 1470 the Earl of Warwick, offended at the king's marriage with Elizabeth Woodville and his patronage of her family, entered into a close alliance with Margaret and raised forces against Edward, who was forced to fly to Holland in October, 1470. Henry VI. was released and restored to the throne, but the restoration was transient. Edward returned in March, 1471, fought and won the battle of Barnet, in which Warwick was slain, and afterwards that of Tewkesbury, in which Margaret and her son were taken prisoners. Margaret was sent to the Tower. Her unfortunate son was put to death, probably by Richard the Crookback, duke of Gloucester, the king's brother. King Henry terminated his days in the Tower about three weeks afterwards, and it has generally been believed that he was disposed of by the same bloodthirsty duke.

In June, 1475, Edward invaded France in the right of Henry V., who at the treaty of Troyes in 1420 had been recognized as successor to the throne of France. But on Louis of France engaging to pay Edward an annuity of 50,000 crowns the English king readily agreed to a peace almost as soon as he landed (the peace of Pecquigny, by which Queen Margaret also was ransomed for 50,000 crowns, and returned to her father, King René of Savoy). Edward was driven indeed to many other shifts and illegal methods, as well as this of a subsidy from France, to raise money for his wasteful debaucheries and extravagant expenditure on the mistresses, favourites, and others that ministered to his personal pleasures. This reign is, however, illustrious as being that in which the art of printing was introduced into England. See CAXTON.

Edward IV. died in 1483. He had by his wife Elizabeth three sons: Edward, who succeeded him; Richard, duke of York, born in 1474; and George, duke of Bedford, who died in infancy; and seven daughters. He had also two illegitimate children.

Edward IV. has the reputation of having been zealous and impartial in the administration of justice, but he deliberately destroyed English freedom for more than a century. Freed from Parliament by the French subsidy and by forced English loans, assisted by an army of spies, backed up by the only military train in the country, so that the barons, weakened by the long civil war, lay at his feet, the crown under Edward IV. towered into solitary greatness, and the ancient English parliamentary monarchy had become a tyranny. It was Edward rather than Henry VII. who laid the foundations of the arbitrary Tudor rule; it was Edward who so weakened the church that a word from Henry VIII. overthrew it like a house of cards. One fact is all-convincing: during a reign of twenty-two years not one single law promoting freedom or remedying abuses was presented to Parliament under Edward IV.

EDWARD V., the eldest son of Edward IV., was born 4th November, 1470. His reign is reckoned from 9th April, 1483, the day of his father's decease, but he never was a king in more than name. The public transactions of his reign all belong properly to his uncle, Richard III. Richard obtained possession of the persons of both the young princes, and having placed them in the Tower, preparatory, as was pretended, to Edward being crowned, he caused himself to be declared king in his stead, on an assertion of the illegitimacy of the children. After this Edward and his brother were seen no more. They are generally believed to have been made away with by Richard's orders, the agents being Sir Robert Brackenbury, Sir James Tyrrel, Miles Forest, and John Dighton. The young princes are believed to have been smothered in their beds, and buried in the Tower. On 17th July, 1674, in making some alterations, the labourers found, covered with a heap of stones, at the foot of an old pair of stairs, a quantity of partially consumed bones, which on examination appeared to be those of two boys of the ages of the two princes. They were removed by order of Charles II. to Henry VII.'s Chapel in Westminster Abbey, where the inscription placed over them recites that they appeared by undoubted indications to be those of Edward V. and his brother.

EDWARD VI., the only son of Henry VIII. who survived him, was born at Hampton Court, 12th October, 1537. His mother, Queen Jane Seymour, died on the twelfth day after giving him birth. His studies began at six years old, and he showed a somewhat extraordinary precocity. He succeeded his father in 1547, when only a little more than nine years old. Henry VIII. had appointed certain executors to exercise the powers of the government during the minority of his son, of whom the chief was the king's maternal uncle, Edward Seymour, earl of Hertford, who was elected by the rest their president; and either received from them in this character, or assumed of his own authority, the titles of governor of his Majesty, lord protector of all his realms, and lieutenant-general of all his armies. He was also created Duke of Somerset, lord high treasurer, and made earl marshal for life.

One of the first acts of Somerset's administration was an expedition into Scotland, undertaken with the object of compelling the government of that country to fulfil the treaty entered into with Henry VIII. in 1543 for the marriage of the young Queen Mary (Mary Queen of Scots) to Edward. The English forces won the battle of Pinkie-clough, fought 10th September, 1547, and had other military successes, but they wholly failed in their object. Mary was conveyed to France by her French mother, Mary of Guise, and there married to the dauphin, afterwards Francis II.

Meanwhile great changes were effected in the domestic state of England. Under Somerset and the new king most of the worst acts of arbitrary power of Henry VIII. were annulled, and measures were taken to establish Protestantism as the religion of the state. Even before the meeting of Parliament the practice of reading the service in English was adopted in the royal chapel, and a visitation, appointed by the council, removed the images from the churches throughout the kingdom. The Parliament met in November, when bills were passed allowing the Cup to the laity, giving the nomination of bishops to the king, and enacting that all processes in the ecclesiastical courts should run in the king's name. By the Parliament of 1548 the use of the Book of Common Prayer and the Catechism was established, and all laws prohibiting marriage among the clergy were declared void. In 1550 were promulgated the forty-two articles (reduced under Queen Elizabeth to thirty-nine).

In the summer of 1549 insurrections arose in many districts in favour of Catholicism and of agrarian reforms. The insurgents were not put down without much fighting and bloodshed, and many of the rebels were executed after the suppression of the commotions. The institution of lords-lieutenant of counties arose out of these disturbances.

A few months after these events brought Somerset's domination to a close. He had listened fairly to the complaints of the poor against encroachments on their commons, &c., but in the eyes of the lords had shown a lamentable weakness in crushing the revolt, bloody though the punishments had been. His Strand palace ("Somerset House") excited envy, and he was accused of bargaining for the cession of Boulogne with France. His execution of his own brother on a charge of treason also went against him in men's minds. On 14th October, 1549, he was taken into custody and sent to the Tower. From this moment John Dudley, earl of Warwick, though without his title of protector, enjoyed his power. Somerset was brought to trial before a committee of the House of Lords on charges both of high treason and of felony; he was convicted of the latter crime, and was executed on Tower Hill, 22nd January, 1552.

Warwick now took the title of Duke of Northumberland, and continued the reign of terror which Somerset had begun. Though Catholics were not put to death, they and their houses and foundations were mercilessly stripped. The nobles seized half the lands of every see (all the lands of Durham), and grew rich with the plunder of chantries and guilds. But at the same time they robbed the crown also. £5,000,000 worth of crown lands were given away by Somerset and Northumberland, and the crown expenditure in the seventeen years quadrupled itself. The coinage was debased, and the country was in the greatest confusion and distress. One good measure alone was obtained amidst this general wreck—the foundation of the well-known eighteen grammar-schools.

In April, 1552, Edward was attacked by small-pox, and although he recovered from that disease the debility in which it left him assumed an alarming appearance. Northumberland now lost no time in inducing Edward to make a settlement of the crown on his own son's wife, the Lady Jane Grey, who was the daughter of the Duchess of Suffolk, granddaughter of Henry VII. Edward's half-sisters Mary and Elizabeth had been both declared illegitimate by Henry VIII. and his Parliament. The settlement was drawn up and signed by the king, and subscribed by fifteen lords of the council and nine of the judges. Edward sank rapidly after this, and lived only till the evening of 6th July, when he expired at Greenwich. His death, however, was concealed for two days, and it was not till the 9th that Lady Jane Grey was proclaimed queen.

EDWARDS, JONATHAN (born at East Windsor, in Connecticut, United States, 5th October, 1703; died 28th March, 1758), a celebrated metaphysician and divine, chiefly remembered as the author of a treatise on "The Freedom of the Will." He was the author, however, of several other treatises, especially of one on the "Religious Affections," and of a "History of Redemption," which have been many times republished. At the time of his death he had just been appointed to the presidency of Princeton College, New Jersey. As a preacher Edwards was especially famous; and according to some authorities he ranks by his writings, in the Calvinistic school of theology, among the greatest luminaries of the Christian church.

EDWIN (*Eadwine*), King of Northumbria and Bretwalda of all England, was the son of Ella, king of Deira, on whose death the throne was usurped by his sister's husband, Æthelfrith, king of Bernicia. Edwin found refuge with Redwald, king of the East Angles and bretwalda. When Edwin had come to manhood he headed an expedition against Æthelfrith, who was defeated and slain in battle in 617, and Edwin ascended the throne of united Northumbria. His valour and abilities eventually acquired for him great power. Bede affirms that his sovereignty extended all over the English, excepting only the people of Kent, and that he also subjected to his dominions all the Britons, and the islands of Man and Anglesey. The great town he founded north of the Tweed retains the name of Eadwinesburh (Edinburgh) to this day, and testifies to the extent of his dominions. The event for which his reign in Northumbria is chiefly memorable is the introduction of Christianity into that kingdom, owing to the influence of Edwin's second wife, Æthelburh, the daughter of Ethelbert, king of Kent, and of Paulinus, whom she had brought from her father's court. Paulinus was made Bishop of Northumbria, his residence being established at York, and the archiepiscopal dignity was soon after conferred upon him by Pope Honorius. Edwin founded the great stone church at York, predecessor of the present minster, and replacing the wooden church of St. Peter, which he first built, and in which he was baptized, 627. The stone church was not finished by Edwin's death, but his nephew Oswald (St. Oswald) completed it when he had won the kingdom from Penda. The Mercians, under their king, Penda, revolted against the supremacy claimed by Northumbria, and a war which arose in consequence was ended on the 12th of October, 633, by a battle fought at Heathfield, in Yorkshire, in which Edwin was defeated and slain, 633. At Edwin's death Æthelburh and Paulinus fled to Kent to the queen's brother, and Northumbria lapsed into heathendom. It was Bishop Aidan from Scotland who again converted it under Oswald, founding the see of Lindisfarn, immortalized by St. Cuthbert. Edwin was so great and wise a king that had he lived probably York, not London, would have been the centre of England; Anglian, not Saxon, the basis of the language—the tongue of Burns, not the tongue of Shakspeare; and the whole course of our continental politics would never have been run. In his day, say the old chroniclers, a woman with her sucking child might fare without harm from one end of the land to the other; and the king hung up brazen cups by all the wayside springs, which cups nevertheless no man attempted to remove. These things were long held for a wonder of the great Edwin's time.

EDWY (*Eadwig*), called the *Fair*, King of England, was the eldest of the two sons of Edmund the Magnificent, but he and his brother Edgar were set aside at their father's death, on account of their youth, in favour of their uncle Edred. On Edred's death, in 955, Edwy became king, and his brother at the same time became the under-king of Mercia. The whole of Edwy's reign was a series of commotions, produced by his life-long contest with Abbot Dunstan (St. Dunstan), whom he eventually banished from the realm. The Chronicles are written by monkish scribes, and it is very difficult, therefore, to ascertain the truth, since they blacken Edwy's character in every way. This much seems clear, that he married a near relative, Ælfgifu (in Latin *Elgiva*), against the prohibition of the church, and that he rudely left his coronation feast for the society of his beautiful queen. Dunstan dragged him back with violence, an insult he never forgave. When, however, his brother Edgar revolted at the head of Mercia and all England north of the Thames, Edwy felt compelled to yield, and to recall Dunstan and desert Ælfgifu. The poor fond queen was seized by Archbishop Oda, Dunstan's friend, conveyed to Ireland, her face seared with a red-hot iron, and at length on her venturing to return to England she was put to death at Gloucester by cutting the sinews of her legs with swords. Edwy died in 959. It is difficult to say whether the expressions of the chroniclers imply that he was murdered, or only that he died of a broken heart. Edgar now became king.

EECKHOUT, GERBRANT VAN DER, born at Amsterdam in 1621, was a disciple of Rembrandt, whose manner of designing, colouring, and pencilling he imitated with much felicity. His masterpiece is the portrait of his own father. He died in 1674.

EECKHOUT, ANTONY VAN DER, son of the above, was born at Brussels in 1656. He painted in conjunction with his brother-in-law Deyster, the latter painting the figures and Eeckhout the fruit and flowers: yet there was such a harmony in their style of colouring and touch, that their works appear to be all by one hand. He usually lived in Italy, but met his death by assassination, owing to a private quarrel, while on a visit to Lisbon.

EEL is a name popularly applied to all fishes with an elongated and snake-like body and no ventral fins. In its widest significance it comprehends the Apoda, a suborder of the PHYSOSTOMI, containing three families, MURÆNIDÆ, Symbranchidæ, and GYMNOTIDÆ, the last of which contains the ELECTRIC EEL, the second a few fresh-water fishes mainly from tropical America and Asia, and the first containing among others the CONGER EEL, and the genus Anguilla, comprising the true eels, with which alone the present article will deal.

Eels (in the restricted sense) have a long body with small scales embedded in the skin transversely and obliquely, so as to resemble lattice-work. The pectoral fins are large; the end of the tail is encompassed by the union of the anal and dorsal fins, the latter not extending forward to the back of the head. The jaws are armed with small teeth arranged in bands. The gill-openings are narrow, situated at the base of the pectoral fins; to this circumstance is due the fact that eels can endure for a considerable length of time removal from water.

The species of the genus Anguilla are numerous; the exact number is uncertain, but Dr. Günther recognizes twenty-five. They are found in the fresh-waters and on the coasts all over the world, with the exception of South America and the west coasts of North America and Africa.

The mode of reproduction of the eel has since the time of Aristotle been a matter of conjecture. The ingenious theories of its generation from dew, horsehairs, or even the skins of old eels, may be at once dismissed. But it was not till late in the eighteenth century that the ovaries of the eel were discovered. In 1878 Dr. Syrski of Trieste found a completely new organ, which there is the strongest grounds for regarding as the male reproductive organ. The eels with this "Syrskian organ" have as yet been found only in the sea and brackish water. It seems certain that the spawning takes place only in the sea. In the autumn a more or less complete migration takes place from the rivers down to the sea and brackish waters. In the ensuing spring the young may be observed ascending rivers, in dense columns, close to the banks, swarming up the moist gates of weirs and locks, and overcoming other obstacles to their upward course. This movement is called the eel-fare. The old eels return to the rivers in the summer irregularly.

As furnishing a nourishing food eels are in much request, though the Celtic races generally, and some other nations, entertain a prejudice against them because of their resemblance to serpents. *Anguilla*, the Latin name for the eel, is retained in modern Italian, and means in fact a little serpent. In the time of Juvenal eels were consumed by the populace at Rome, but were despised by the wealthy classes on account of their feeding in the sewers. No such dislike appears to have been entertained in England in after-times; and the cellaress of Barking Abbey is ordered by the statutes of that religious house to provide eels for food during Lent. Dutch fishermen are the chief suppliers of this article of food; but considerable quantities are imported from Ireland, eel fisheries being established on the Shannon and elsewhere in that island. A great consumption of eels also takes place in the manufacturing districts of England, so that altogether, though they cannot be classed as an important item in the staple food of the nation, they are useful as a variety of diet and a cheap luxury. Eels are taken in the fenny districts by barbed spears of several prongs which are plunged into the mud and withdrawn again often with one or more eels impaled on the barbs In rivers a more regular fishery is carried on by fixing a barrier of wicker baskets across the stream. Many are also caught by hooks, baited with worms or fish, and set over-night. Frost or bright moonshine are adverse to success in this kind of fishery. The New York market is supplied with eels at all seasons, the fishery being carried on in summer by eel-pots, nets, or by bobbing in the evenings with a bunch of tough bait; in winter eels are procured by spearing in the mud.

The common English species (*Anguilla vulgaris*) is spread all over Europe, and extends into North America. It is not found in the Danube or in the Black and Caspian Seas. It is sometimes called the sharp-nosed eel, and specimens with broad snouts are often specifically distinguished. However, according to Dr. Günther, every degree of breadth of the snout may be observed, and "a much safer way of recognizing this species and distinguishing it from other European eels is the forward position of the dorsal fin; the distance between the commencement of the dorsal and anal fins being as long as, or somewhat longer than, the head." These eels grow usually to a length of about 3 feet, but specimens 5 or 6 feet long have been captured. In the second English species, the Grig (*Anguilla latirostris*), the dorsal fin is placed further back, and the snout is always broad. It occurs throughout Europe, in China, New Zealand, and the West Indies.

EEL-POUT is an English name applied to the BURBOT (*Lota vulgaris*), and also to the viviparous BLENNY (*Zoarces viviparus*).

EFFEN'DI (Turkish, master), a title of distinction in the Turkish Empire, applied to different officers of rank, particularly to emirs, priests, and men of learning. *Reis-effendi* is a title given to the grand chancellor of the empire.

EFFERVES'CENCE is the rapid disengagement of a gas which takes place in a liquid in consequence of chemical action and decomposition.

EFFLORES'CENCE. This term is usually applied to crystalline salts which in dry air lose their water of crystallization and become pulverulent. The most common instance is ordinary washing-soda, or crystalline sodium carbonate, or Glauber's salts, or sodium sulphate. An efflorescence of a salt is often seen on porous bodies which contain the salt in solution, the solution being drawn to the surface by capillary attraction and evaporated. Instances of this efflorescence are common, as in saltpetre on the earth in caves, alum on alum shale, iron sulphate on pyrites, and sodium sulphate on walls. The latter is a very common inconvenience to builders on walls of houses, especially where sea-sand has been used in the mortar; it comes through the plaster and destroys paint and paper. The beautiful painting of the pillars in the first Pompeian court in the Crystal Palace at Norwood was ruined by this efflorescence.

EFT. See NEWT.

EGALITÉ, PHILIPPE. See ORLEANS, DUKE OF.

EG'BERT (*Ecgberht*), styled the *Great*, King of Wessex, was an undoubted descendant of Cerdic, and the representative, if not the only remaining male descendant, of that founder of the royal house of Wessex. Beorhtric, king of Wessex, in 786 drove Egbert into exile for thirteen years. He spent this time with the Emperor Charles the Great (Charlemagne). On the death of Beorhtric, in 802, he was recalled, and by the unanimous vote of the witan appointed to the vacant throne. Egbert to his own kingdom of Wessex quickly added Kent, Sussex, and Essex and set over them his sons as under-kings. Northumbria, Mercia, and East Anglia, though not his own, he soon made his submissive vassals. Finally, between 809 and 814, he reduced to submission all Cornwall, Devonshire, and North Wales. Thus Egbert became bretwalda of all England, and more powerful than any ruler before him had been; and in a small way he was like his patron and model Charles the Great. He did with the various states of England as Charles with those of the Continent, and as the one made the Franks the leading nation, so did the other with the people of Wessex. It is owing to Egbert's greatness that the south of England has up till our own day led the north. In yet another thing did Egbert resemble Charles, namely in having to resist the first attacks of the fierce Northmen, destined one day to subdue the descendants of both. Egbert died in 837, and was succeeded by his son Ethelwulf (*Æthelwulf*).

EGG (Lat. *ovum*). Strictly speaking all animals, not excepting man, are at the commencement in the state of impregnated *ova;* but the word egg is in common acceptation limited to those ova which are extruded as such, and the young contained in which complete their development apart from the parent. Such are all the invertebrate ova, and such are the eggs of fish, reptiles, and birds. All eggs of birds are edible, but the eggs of the domestic fowl are so valuable as food that a few special remarks are necessary upon them. Considerations of development within the egg are to be found under DEVELOPMENT and EMBRYO. Hens' eggs are nutritious and easily digestible; and when lightly cooked by boiling, and eaten with a little salt, are admirably adapted as an aliment for the sick and delicate. When boiled hard or fried they are rendered less digestible, and possess no advantage in this respect over butchers' meat. A new-laid egg beaten up in a cup of tea, coffee, or chocolate is an excellent ingredient in the breakfast of a person with a poor appetite, and is very nourishing. A glass of wine, beer, or porter, similarly treated, along with a biscuit, has been recommended as a light and nutritious luncheon or supper, well suited to the debilitated and dyspeptic. Raw eggs may be advantageously substituted for cod-liver oil in all cases in which this last is ordered for persons with delicate or irritable stomachs. The addition of fresh salad oil vastly increases their medicinal virtues. A fresh egg is said to contain about the same amount of nourishment as 1½ oz. of fresh meat and 1½ oz. of wheaten bread, and takes about as long as mutton to digest, *i.e.* three to four hours.

The new-laid egg of the common domestic fowl consists of the calcareous *shell*, the *shell membrane*, the *white*, an albuminous substance, the *yolk*, and the central cavity of the yolk. The very thin skin which covers the yolk is the *vitelline* membrane. The average weight of the hen's egg is from 1½ to 2 oz.; that of the duck, from 2 to 3 oz.; that of the turkey, from 3 to 4 oz.; and that of the goose, from 4 to 6 oz. An egg kept for two years in a dry situation is found to lose at least 544 grains from the evaporation of a portion of its water through the shell. Boiling in water also causes eggs to lose from 2 to 3 per cent. of their weight.

Eggs may be preserved for any length of time by excluding them from the light and air. One of the cleanest methods of doing this is to pack them with the small end downwards in clean dry salt, in barrels or tubs, and to place them in a cool dry situation. Or they may be placed in vessels containing milk of lime or strong brine, or rubbed over with butter, lard, or gum water; or, as in France, by melting bees-wax with twice its weight of olive oil, and applying the mixture all over the egg with the tip of the finger; the shell absorbs the oil, the wax fills up the pores, and the egg is said to keep good for two years. Lamont's plan keeps the substance of the egg in a dry state. The contents of the eggs are placed in a long covered trough, the yolk and white are agitated by a revolving shaft having two or more discs mounted on it, and when the discs are removed, with egg covering them as a film, a current of air dries the films, which are then scraped off in fine scales or irregular powder. The discs are remounted on the shaft, and a further portion similarly treated. The powder—of which one pound is procured from forty or fifty eggs, and which will keep good a long time—is dissolved in water and beaten up when required for use. Eggs for keeping should never be laid on their sides, and when kept in the air should be occasionally turned to prevent the yolk attaching itself to the side, instead of floating in the albumen. The practice of packing eggs in damp straw, or in anything else that can convey a flavour, should be carefully avoided. The shells of eggs are porous, and readily admit the passage of fetid odours. The feeding of the fowl also has far more influence over the flavour of the egg than is usually supposed; the eggs of fowls which run wild are far less rich than those of barn-door fowls, and these are improved if the fowls have kitchen scraps with their food. It is hardly necessary to add that the eggs of various breeds of fowls differ much in richness and delicacy. As a rule large eggs (of any bird) are coarse, and small eggs refined. Those of the plover are considered the greatest delicacy in eggs.

An ordinary hen's egg contains 2 drachms of oil, and a duck's egg far more. This oil is extracted in Russia, and is a favourite medicine. An egg weighing 1¾ oz. contains 120 grains of carbon and 17¾ grains of nitrogen. The full chemical composition is as follows (Lawes and Gilbert):—Fresh weight, 1·8 oz., whereof water 1·35 oz. and solids ·45 oz. Of the latter fat gives ·198 oz., salts ·025 oz., carbon ·275 oz., nitrogen ·036 oz. By percentages, therefore, we have—solids 25 per cent., salts 1½, dry fat 11, nitrogen 2, carbon 15¼ per cent.

EGG TRADE. The importation of foreign eggs into England is large and rapidly increasing. In 1844 they amounted in number to 67,000,000; in 1883 to over fourteen times the number, viz.—940,000,000, value £2,728,396. About five-sixths come from France. In the provinces of Normandy, Picardy, and Burgundy the farmers and small landed proprietors attend to poultry culture with a degree of system hardly known in England, where it is regarded more as a matter of cottage husbandry. It is the greatly extended use of white of egg in some manufactures and photography which has led to the surprising increase in

importation. They are brought in boxes of 600 or 1200 each, it being customary to reckon eggs by the "great hundred" of sixscore, or 120. The value averages on importation about 6*s.* per 120. The imported eggs are not equal in quality to those produced at home, as the odour of the damp straw in which they are often packed penetrates the shell, and produces a strong and unpleasant flavour.

EGG-PLANT (the *Solanum Melongena* of Linnæus, and the *Solanum esculentum* of Dunal), a plant that was introduced into this country in the year 1597. It grows to the height of from 2 to 8 feet, and has leaves of an ovate form, which, as well as the stem, are prickly and downy; its flowers are generally of a violet colour, and its fruit is a large ovate or globose berry resembling a hen's egg, but sometimes larger, whence the name of egg-plant, which has been given to it.

There are many varieties of this plant, of which two only are commonly cultivated in gardens, namely, the small white and the large purple. They are raised from seed, which should be sown early in spring, in light soil on a hot-bed, and treated in every respect like a tender annual. Of the two varieties above named that with white fruit is small, and rather an object of curiosity than of use; the other with purple fruit, which sometimes attains a pound weight, is a favourite article of food in hot countries. Under the names of *brinjal* and *bangan* it is well known in India, and by that of *aubergine* in France. C. B. Clarke in Hooker's "Flora of British India" considers *Solanum incanum* and *Solanum insanum* to be the same species as this, but is doubtful whether it is found truly wild in India. It is cultivated in both the eastern and western hemispheres, but A. de Candolle thinks that it is probable that the wild plant was Asiatic, not American.

EG'HAM, a quiet little town of England, in the county of Surrey, 21 miles S.W. by W. from London on the London and South-western Railway, is situated near the south bank of the Thames, in a pleasant and healthful district. It is connected with Staines on the other side of the river by an iron bridge. Its church is modern, but contains the memorials removed from the ancient building, among others that of Sir John Denham, the father of the poet, who resided in what is now the vicarage house. Close to the town rises the picturesque ridge of Cooper's Hill, celebrated in Denham's poems, and along the Thames stretches the historic plain of Runnimede, where King John signed Magna Charta, the bulwark of English freedom. Opposite to it lies Charter Island, which by some authorities is considered to have been the true scene of the interview between the king and his barons. The population of Egham in 1881 was 7389.

EG'INHARD (Eginhardus, or Agenardus, or Einhardus, and even other spellings of the name freely occur) was the secretary, minister of public works at Aix-la-Chapelle, and biographer of the Emperor Charles the Great (Charlemagne). He was a man of great culture, a friend of Alcuin and the learned society the emperor gathered at Aix; he was fluent in Latin, and knew as much Greek as the learning of the times afforded. His "Life of Charles the Great" ("Vita Caroli Magni") is excellent in every way, unusually so considering its early date. It is in Latin, and is very free and fair in its comments. He was born of noble parents in what is now Hesse-Darmstadt in 775, and soon rose to high influence with the far-seeing emperor; in fact, it was through Eginhard entirely that Charles raised his son Louis to partnership in the empire. In 815 (after Charles' death) Louis, now sole emperor, bestowed an abbey on Eginhard, or probably rather the benefit of the abbatial revenues, and made him tutor of his son. He served Louis as faithfully as Charles, and was much more lavishly rewarded, many monasteries having counted him as their head. In 831 he retired from court-life, and died in 840.

The legends told of Eginhard and by Eginhard, though curious and amusing, cannot find fit place here. Two traits of character are, however, so often alluded to as to need briefly telling. The first is his courtship of Emma, daughter of the great Charles, both he and the princess dreading the wrath of the fierce monarch should their attachment be discovered. Once while he talked with Emma by night the snow fell, and it was impossible for him to return to his own quarters without his footsteps betraying that some man had visited the princess. Emma's quick wit solved the difficulty by suggesting that she should carry her lover across the courtyard, as her woman's footsteps would not provoke remark. Charles saw the whole from a window, and as he knew Eginhard's real merit he forgave the pair, and permitted their marriage. It must be added that great doubt is thrown on this charming and well-known story. The wife's name is supposed to have been Imma, and she was sister of the Bishop of Worms. The other is a fact that Eginhard himself relates in his "Historia Translationis SS. Marcelli et Petri." These were two martyred saints (Peter not being the apostle, but another martyr of that name) whose bodies were stolen from their tombs in Rome by servants sent for that purpose by Eginhard and Medard, abbot of Soissons. The bodies were carried safely to Seligenstadt—Eginhard's final retreat in the Odenwald—except a limb or so which other stealers had stolen on the way from the first sacrilegious burglars. Eginhard sees nothing wrong in this sacrilege, writes a book about it, and publishes 150 pages of miracles wrought by the bones of the two saints.

EG'LANTINE, the Old English name of the sweet-brier rose (*Rosa rubiginosa*)—*églantier* in French. Milton misapplies the word to the honeysuckle in the following lines:—

> "Through the sweet-brier, or the vine,
> Or the twisted eglantine."

The name has also been applied to *Rosa Eglanteria* and *Rubus Eglanteria*.

EGLANTINE, FABRE D', a speculative pamphleteer of the revolutionary era in France, was one of the leaders of the terrible Convention. He did some useful work, however; among other things he helped to form Romme's famous Revolutionary Calendar. He it was who gave the new names to the months, descriptive names, rhyming each to each in its season, *Nivose*, *Pluviose*, *Ventose* for winter to spring; *Germinal*, *Floréal*, *Prairial* for spring to summer; *Messidor*, *Thermidor*, *Fructidor*, summer to autumn; *Vendémiaire*, *Brumaire*, *Frimaire*, late autumn to winter. The twelve months being of thirty days each, five days remained over (six in leap year); these d'Eglantine designated the *Sansculottides*, and named them respectively the Festivals of Genius, of Labour, of Actions, of Rewards, and of Opinions. The leap year, extra sixth Sansculottide, was the Festival of the Revolution. The "weeks" (decades) were of ten days, not seven, three decades to a month. Sunday so unhesitating a generation did not scruple to sweep out of existence. D'Eglantine seems, however unhesitating with regard to Sundays, to have hesitated to go the length of the Terror. He was therefore thrown into prison by the Robespierre faction in March, 1794, at the time that Danton, weary of slaughter, had withdrawn himself. Fabre d'Eglantine was accused of peculation in Indian affairs. In less than a month Danton himself had been struck at, and on the 2nd of April, 1794, d'Eglantine stood by the side of that "Titan of the Revolution" on trial before the shameful Fouquier-Tinville tribunal. Few escaped that ordeal. D'Eglantine died by the guillotine on 10th April, 1794.

EGREMONT, a neat little town of England in the county of Cumberland, 5 miles S.S.E. from Whitehaven, and 340 from London by the North-western Railway, and about 3 miles from the sea. There are a parish church,

dissenting chapels, some schools, and a mechanics' institute. The town consists chiefly of one long street, and its manufactures consist of linen, canvas, and paper. In the vicinity there are iron mines. On the west side of the town are the ruins of an old castle, supposed to have been built by the Normans, and celebrated by Wordsworth. The town of Egremont confers the title of earl on the Wyndham family. The population in 1881 was 5976.

E'GRET is the name given to some species of the genus Ardea, distinguished from the HERONS by their snow-white plumage and by the possession in the breeding season of crests and plumes of feathers on the back. The Great Egret (*Ardea egretta*), figured in Plate IV. of BIRDS, is an inhabitant of both North and South America. This bird is adorned with a sort of train of long plumes, descending from the upper part of the back, and falling gracefully over the tail. Including these plumes it measures upwards of 4 feet in length. In the United States this is a migratory bird, inhabiting the swamps and rice-fields of the Southern states. Its nest is built on the cedars in the same way as that of the common heron, and the birds usually collect in considerable societies during the breeding season.

The name Great Egret is also applied to a species, *Ardea alba*, which breeds regularly in the south of Europe, and occasionally strays into Britain. It closely resembles the American species. A larger species, *Ardea occidentalis*, from Florida and Cuba, is known.

The Little or Lesser Egret (*Ardea garzetta*) is a native of the south of Europe, and at one time used to be met with in this country. This pretty bird is much esteemed for its pure white feathers, and especially for the glossy plumes which adorn its head, breast, and shoulders. Its feet and back are black. "This," says Dr. Fleming, "is supposed to be the species, a thousand individuals of which were served up under the name of *egrittes*, at the celebrated feast of Neville, archbishop of York, in the reign of Edward IV. It is possible, however, that the lapwing may have been there referred to, as the most common bird with a crest."

EGYPT (the *Khem*, black land, of the hieroglyphics; the *Khemi* of Coptic; the *Mizraim* of Scripture; Greek, *Aiguptos*; Arab. *Misr*), a country on both banks of the Nile, occupying the north-east angle of the African continent; one of the earliest seats of art, science, and literature, and famous alike for the historical events of which it has been the theatre, its magnificent monuments, and remarkable physical character.

Boundaries and Extent.—Recent modern Egypt included until 1884 not merely the historical land of the Pharaohs—the Nile valley and a limited area of the deserts which bound it—but also the wide-spreading provinces of Nubia and the Soudan, Dongola and Berber, Khartoum, Senaar, Kordofan, Bahr-el-Abyad, and Darfur; the Somali country south of Abyssinia, from Harar to the Indian Ocean; the equatorial regions beyond Gondokoro to the Victoria and Albert lakes; the African coast of the Red Sea from the Gulf of Aden to Suez, and even the east side of the Gulf of El-Akabah—altogether about 1,500,000 square miles. But a great part of this immense territory consists of wide stretches of unexplored desert, and of waste tracts traversed only by the untamable Bedouin; the authority of the khedive was in some sense more or less recognized, but his actual hold upon the country was extremely slender; and in view of the difficulties which seemed threatening the position in 1884, the claim to the greater part of this vast region was upon the suggestion of the British government relinquished. To-day, as in the remotest antiquity, the true Egypt, as defined by the natural boundaries of land and race, is the valley of the Nile, from the first Cataract (at Assouan, the ancient *Syene*) to the Mediterranean. In indicating the legitimate boundary of Egypt when the Soudan was given up, the second Cataract at Wady Halfa, 22° N. was mentioned by the British government, and this point may therefore be regarded for the present as the most southern extension of Egypt proper. Thus limited Egypt dwindles to its true area of 16,500 square miles, or little more than half the size of Ireland. At no great distance from the river, on either side, rise a series of hills, which constitute at once the boundaries of the valley and the margins of great deserts. The country within these boundaries is of a form which defies all preconceived notions of political geography and the general fitness of things. Here is a country about a thousand miles long, and so disproportionately narrow that a very ordinary pedestrian can walk across it at almost any place in a few hours, and at some points in a few minutes. The whole has been compared to a tall, straight, branchless palm tree, the roots stretching far south into Central Africa and the feathery tuft of foliage spreading out on the Mediterranean coast. Small as it may seem, this was the land of the Pharaohs and the Ptolemies; and in this narrow Nile valley those vast monuments were built, those inscriptions written, that religion and philosophy developed, whereby Egypt gave the impetus and direction to much of the art, science, and thought of the world. Some five centuries before Christ, Herodotus described Egypt as "the gift of the Nile," and his observation is true in the strictest and most literal sense—for without the Nile there would be no Egypt; the great African Sahara would spread uninterruptedly to the Red Sea. Egypt is simply a groove worn by the Nile in the desert, and made habitable by its waters. The overflowing of these in their annual inundation, and the spreading of the famous Nile mud, is the one reason that the most fertile country in the world is not as barren as the deserts that bound it.

Most of the countries named as having been till recently within the political limits of Egypt are described under their several headings. In the present article we propose to include—1, The valley of the Nile, or Upper Egypt; 2, the Delta, or Lower Egypt; 3, the Western desert and the oases therein inclosed; 4, the Eastern country towards the Red Sea.

1. *The Valley of the Nile.*—The Nile, coming from Nubia, runs through a deep and narrow valley, sunk between two ridges of rocky hills, which rise in some places more than 1000 feet above the level of the river. At Wady Halfa, the second Cataract, the free navigation of the Nile ends, except at the full height of the river. At low water, indeed, it is often difficult to pass beyond the first of these shoals or rapids, at Assouan. Northward from Assouan the breadth of the valley varies considerably, but it is seldom more than 10 miles, and in many places it is only 2, including the breadth of the river, which varies from 2000 to 4000 feet. The cultivable land generally is much broader on the western bank than on the eastern. As the river enters the Egyptian territory from Nubia the granitic hills bear the appearance of having been rent by the stream. Hence, between the isle of Philæ and Assouan the current is interrupted by innumerable islands. Others of a less rocky character—some of them extensive, considering the breadth of the Nile—spring up out of its bed at various intervals during its progress to the Mediterranean. The isle of Elephantine, opposite Assouan, wears so beautiful an aspect that it is called by the natives the Isle of Flowers, and most European travellers describe it as a sort of terrestrial paradise. The Egyptian valley is strowed with those stupendous monuments of human labour, those beautiful remains of ancient art, which have excited the wonder and admiration of ages, and which seem the more marvellous the more closely they are examined. It is chiefly between Assouan and Cairo that the most interesting monuments of the ancient Egyptians are met with. They consist

principally of—(1) Temples, on which are sculptured the conquests of the kings; the animated battle-field, the beleagured city, the return in triumph, are all accurately portrayed. (2) The extensive tombs excavated on the hills bear delineations of funeral processions, of feasting, of hunting, of all the industrial operations, from husbandry to chair-making, and even brickmaking; they are, in fact, a complete work on the manners and customs of that extraordinary people. (3) The gigantic statues and tall obelisks, consisting of solitary blocks of granite thousands of tons in weight, and transported hundreds of miles from the quarry to the sites on which we now find them, tell us of wonderful skill and perseverance; while to future ages the pyramids will remain as the monuments of a mighty people. See EGYPTIAN ARCHITECTURE, PYRAMIDS.

The distance from Assouan to the Mediterranean is 730 miles, or to Cairo 550, and along almost the whole of the latter distance there are on both sides of the river remains of cities so ancient that they seem to reach right back to the period which used to be regarded as that of the creation of man. Wady Halfa, at the second Cataract, is 200 miles southwards from Assouan.

2. *The Delta.*—The Nile, issuing from the valley a few miles north of Cairo, enters the wide low plain which, from its triangular form and its resemblance to the letter Δ, received from the Greeks the name of the Delta. The river divides into two branches, that of Rosetta or old Canopic, and that of Damietta or Phatnitic. The figure of the Delta is now determined by these two branches, although the cultivated plain known by that name extends considerably beyond to the east and west, as far as the sandy desert on each side. There were formerly other outlets for the Nile, named the Pelusiac, the Tanitic, the Sebennytic, and the Mendesian, but these have become in great measure choked up. Although the journey by river from Cairo to the coast is less than 200 miles, while between Cairo and the first Cataract there are nearly 600 miles of Nile, the breadth of the Delta makes it the larger half of Egypt, with an area of 6350 square miles, out of a total of 11,342 of cultivable land. The alluvial soil is shallower, and the vegetation less exuberant than the amazing fertility of the upper valley; but the Delta is nevertheless a rich tract of well-watered and uniformly cultivated land, with very few barren spots. Its agriculture, especially the cultivation of cotton, together with the transport and export trade, support a number of flourishing towns. The coast line of the Delta is singularly uninviting, consisting of a low ridge of desolate sand-hills, diversified only by a series of dreary salt marshes, known as Lakes Menzaleh, Bourlos, Etko, Aboukir, and Mareotis. Their baneful influence is felt some distance inland, and to their presence is attributable the depressing hothouse climate which must result from a girdle of nearly stagnant lakes in a state of constant and rapid evaporation. All the lakes are separated from the Mediterranean by sandy stripes of coast, more or less narrow, upon which the four ports of modern Egypt are built—Alexandria, Rosetta, Damietta, and Port Said, the latter the creation of the Suez Canal.

The interior of the Delta is a wide level plain, intersected by a network of canals fed by the divided stream of the Nile, often running in ancient channels, and fenced in by high embankments. Near the banks of the canals and river-arms are some 300 small villages and a few towns, generally erected high above the inundation, on the lofty mounds of dark earth, the sites of ancient cities and temples, which are a prominent feature of the plain. At a distance the villages look almost a part of the mound. For the most part they are merely a cluster of mud-huts surrounded by dove-cotes and palm-groves, with a white-washed minaret standing out from the confused mass; but many take a fair share in the trade which the fertilizing Nile affords to the plain, and have developed into small but populous towns, possessing a definite high street and mosques whose minarets overtop the houses and palms.

The scenery varies with the season of the year. In August and September, unless the inundation has been a low one, nothing is to be seen but the villages and their palm-groves rising out of the vast sheet of water spread over the plains, with here and there a raised bank, used, at this season, as a road to pass from village to village. In October and November the eye rests on plains of bare dried mud; but the husbandmen are now busy sowing the seed as the Nile retires within its channel, so that it may have sufficient moisture to germinate ere the ground be dried up by the scorching sun. In December, January, and February, the country presents a deep green colour of the richest hue. Then the whole plain is clothed with rich crops of all manner of corn, and with the bright blossoms of the cotton plant. In May and June, the harvest having been all gathered, the face of the ground again assumes its dry brown appearance. Every inundation deposits a thin stratum of mud, derived from the rocks of Abyssinia, where torrents of rain (or rather deluges) fall in the early summer months (April and May). These carry with them the soluble ingredients of the rocks and soil, as lime, potash, soda, &c. The seed is sown either on the land just as the water left it, or after a slight scratch has been made by a primitive plough. The extraordinary fertility of the soil enables the inhabitants to produce, with a small amount of labour, sufficient for the necessities of life; and as the government, instead of themselves, would reap the benefit of any great surplus, they have no desire nor do they attempt to increase the fertility of the soil by any advanced methods of cultivation. Consequently they do nothing more than sow the seed, cover it in the easiest and quickest way possible, and attend to the irrigation of the land during the progress of the crops. The cultivated lands are of two kinds—those low enough to be covered by the annual inundation, and those lying too high for this to reach them. The former yield, for the most part, only one crop in the year; while the latter are made to yield three, and are artificially irrigated. The crops produced on the former are wheat, barley, lentils, beans, lupins, and pease. The first crop of the latter is generally wheat or barley; then millet (*door'ah seyfee*), indigo, cotton, &c.; and, thirdly, millet again or maize (*door'ah shamee*), which may be seen in full ear in December. Irrigation is effected by raising water from the river, and sending it off in channels down the sloping banks, the land being laid off into square patches. When a patch of crop requires watering, all that is necessary is to make a depression with the foot in the little bank of the channel and the water flows over. It is thus "a land watered with the foot."

Lower Egypt, and the valley of the Nile in Upper Egypt, are entirely composed, to a considerable depth, of the rich alluvium deposited by the river during a long series of ages. In the ranges bounding the valley and in the desert we find limestone, two kinds of sandstone, clay and other slates, with granite, phorphyry, and other igneous rocks. A broad zone of marine limestone extends from the Red Sea across the valley of the Nile, and into the Libyan Desert. It extends from Cairo to Esné, some distance south of Thebes. In the vicinity of the Nile its strata are nearly horizontal, and this gives a flat, tabular aspect to Middle and part of Upper Egypt. The rock was used extensively in the construction of the temples of Lower and Middle Egypt, and some of the pyramids are built entirely of it; and in it are cut the immense catacombs of the ancient Egyptians. It contains echinites, nautili, corallines, crabs, fish teeth, and nummulites, and seems to be of lower Eocene age. It also contains layers and nodules of flint; over it is a sandstone containing tertiary forms, salt, and gypsum, but existing only in detached hummocks. It is

in this formation that the natron pools occur. South of the limestone zone at Esnć occurs a sandstone, the lowest strata of which are agglutinated quartz pebbles, cemented by lime and iron. It contains no fossils, and was the rock used in the temples and monuments of Upper Egypt. It is met with across the whole Eastern Desert, lying on the granite, greenstone, and other hypogene rocks which occur in many parts of that district, on the Nile at the Cataracts, as well as a few miles north of them, and at the famous quarries of Assouan, from which all the granite monuments of Egypt have been taken.

3. *The Western* or *Libyan Desert.*—The nominal limits of Egypt along the sea-coast west of Alexandria are the mountains of Akabah-et-Soloum, about 25° E. lon., where the nominal limits of Tripoli begin. This westward extension from the Nile valley, however, is for the most part an extensive tract of desert occupied by independent tribes of nomadic Arabs. It presents a scene so formidable that few travellers have visited the oases by which it is here and there interspersed. The most northern of these, some fourteen days' journey from Cairo, is Sivah or Ammon, once famous for its temple of Jupiter Ammon, whither Alexander made a pilgrimage to consult the oracle. South-east of Sivah, and nearer to the Nile, is the Little Oasis, or Wah-el-Bahryeh, the chief village of which lies in lat. 28° 16′ N. and lon. 28° 55′ E. South and west are the small oases of El Hayz, Farafreh, and Zerzoora; and still further south is the Dakhleh oasis, whose first European visitant was Sir A. Edmonstone, in 1819. Its chief village stands in about lat. 25° 35′ N., and lon. 28° 55′ E. Three days' journey to the east brings the traveller to the Great Oasis, or Wah-el-Khargeh, extending in length from 24° 30′ to near 26° N. lat. Instead of islands of the blest (Gr. *Makáron nesoi*) springing up amidst the surrounding and desolate ocean of sand, as the ancients describe them, the oases are valleys or *depressions* of the lofty plain which forms the extensive table-land of East Africa. On descending to them they are found to bear, in many respects, a similarity to a portion of the valley of Egypt, being surrounded by steep cliffs of limestone, at some distance from the cultivated land, which vary in height in the different oases, those rising from the south oases being the highest. Neither do they present a continuation of cultivable soil, all of them being intersected by patches of desert. They no doubt owe their origin to the springs with which they abound, the decay of the vegetation thence arising having produced the soil by which they are now covered. Their fertility has been deservedly celebrated; but the glowing eulogiums of travellers on their surpassing beauty are probably, in a great measure, to be ascribed to the striking contrast they present to the surrounding deserts of arid burning sand. The water which filters through under the desert rock, and vivifies these green patches, comes from a considerable depth, for it is always warm (85° to 90° Fahr.), seemingly inexhaustible, and rises with such force that the painful labour of the Nile irrigation is superfluous in the oases. The entire population of the oases is about 35,000. The produce of the soil scarcely does more than support the population, and the only export of importance consists in dates of a peculiarly fine flavour. Under the Romans the oases were places of banishment, not because of anything noxious or disagreeable about them, but because of their being as it were out of the world, and from the extreme difficulty of escaping from them. Besides the oases the Libyan desert is relieved by the Nitrain valley, a sort of hollow some 20 miles long, bounded by low hills, and containing, especially at the time the Nile is at its highest, a chain of pools or lakes whence salt and natron are extracted. The valley is 50 miles north-west of Cairo. About 50 miles south of the Wadi Natróon, as it is sometimes called, and about the same distance south-west of Cairo, begins the fertile valley of Faioum, considerably lower than the banks of the Nile south-east of it. It is but a short distance west of the Nile, from which it is separated by a range of limestone hills. The Bahr Jusef, or river of Joseph, is an ancient channel of the river which passes off from the present one at Daroot; and, having watered the west side of the plains for some distance, enters the Faioum by an opening in the Libyan hills, and is conducted to different parts of the Faioum by canals. The part of the Faioum under cultivation is about 23 miles from N. to S., and 28 miles from E. to W. At its north-west part is the Birket-el-Kharoon, or Lake Moeris, which is 35 miles long from E. to W., and 7 broad. During a high inundation this lake is raised 5 or 6 feet by the water it receives through the Bahr Jusef.

4. *The Eastern Country.*—The large tract between the valley of the Nile and the Red Sea is a mountainous region, which, although generally rocky and barren, is intersected by numerous wadys or ravines, fertilized by springs, and clothed to some extent with vegetation. Unlike the Libyan desert on the other side of the Nile valley, which loses itself in the boundless Sahara, the eastern desert country has the definite boundary of the Red Sea, and is more substantially within the government of Egypt. The mountains and hills form so large a portion of this desert that the Egyptians call it Jebel, "the hills"—jebel being a single mountain or hill, no matter what its height may be. The plains are small, with the exception of that between Cairo and Suez —which is now, as it has been since and before the days of Joseph, the highroad from Arabia and Syria to Egypt— and the flat lying between Suez and the Mediterranean, above which the former rises to the height of a few hundred feet (700, Newbold), while the latter is partly below its level. Of the valleys traversing this desert some run north and south, parallel to the valley of the Nile; while others, from a summit-level in the interior of the desert, pass east to the Red Sea and west to the Nile. Of the latter the two principal are the Wadi-et-Tih, or Valley of the Wanderings, a short distance south of Cairo and Suez. Another of this class of valleys is that leading from Keneh and Thebes to Cosseir, on the Red Sea. There has long been a good road across the plain from Cairo to Suez, and also a railway. This undulating plain rises gradually from the valley of the Nile, but drops more abruptly down to the extensive gravelly plains west of Suez, and is crossed in a northerly direction by numerous shallow water-courses. The road is protected from the driving sands by banks. The railway from Alexandria to Cairo is continued to Suez. In ancient times the roads leading from the valley of the Nile to the shores of the Red Sea passed by regular stations and villages and towns with a resident population. Mines of various metals and quarries of porphyry and other valuable stones are scattered among the mountains, and were once regularly worked. At present the only fixed habitations are at the port of Cosseir, and at the Coptic monasteries of St. Anthony and St. Paul. Cosseir is about 90 miles from the Nile, at the eastern extremity of the Wady Arabah, which is inclosed by two ranges of mountains called Jebel Kelalla. A range called Jebel Ghrarib, about 28° 15′ N. lat., has peaks 6000 feet high. Many remains of antiquity are scattered over this district.

Flora and Fauna.—Cotton is by far the most important crop; but rice and the sugar-cane, flax, hemp, tobacco, oranges, and tropical fruits are grown. The vine is little cultivated, as the Koran forbids the use of wine. Henna, or the Egyptian privet, grows near the Cataracts; its leaves yield a rich red dye. From the character of the surface the country has very few wild plants.

Of wild animals the wolf, hyæna, jackal, and jerboa, or kangaroo rat, inhabit the desert. The hippopotamus and the crocodile, frequent in ancient frescos, now descend the river no further north than the neighbourhood of Farshoot. Among domestic animals the cow and buffalo are used in

ploughing, the camel for burdens, and the ass and mule for riding. Mutton is the usual meat, beef is only killed for foreigners. Pigs are, of course, rarely kept. The horses are few and of an inferior breed, while the asses and mules are large and active and lively animals, and if very good bring a higher price than horses. The Egyptian is larger than the Arabian camel, of which the dromedary is not a species, as often stated, but *a camel trained for riding*. The fish of the rivers are inferior for table purposes. The birds of the country are very numerous. Wild geese and ducks exist in immense numbers, and their flesh has a most delicious flavour; while flocks of pelicans often darken the air, and the stork is occasionally seen. Our common heron is plentiful; and the palm-groves swarm with pigeons, hawks of all sizes and kinds, and with vultures, while many pretty species of small birds haunt the acacia groves. In Upper Egypt the sacred ibis may often be seen, and at certain seasons immense flocks of quails visit the valley of the Nile, and the partridge may always be found where the cultivated land joins the desert. The crocodile-bird, which gives the alarm at the approach of danger, is a species of lapwing, and is almost entirely confined to Upper Egypt, where the small, white egret is common; it has a horny spine on the point of the shoulder of each wing. The dogs of Cairo are a well-known nuisance. Being "unclean" few native persons will consent to be their masters, and they run half wild in great numbers. Cats are almost as numerous, but some of them are better cared for, under the pretext that the Prophet loved cats, really, there is no doubt, from a relic of the ancient worship of Pasht, the cat-goddess of Lower Egypt. One of the Mamalukes founded an hospital for destitute cats at Cairo. Its revenues, however, have been long since sequestrated.

Climate.—The climate of Egypt is one of extreme dryness, and thus the excellent state of preservation in which we find the sculptures, hieroglyphics, and paintings of the ancient Egyptians is accounted for. There are two seasons —the temperate, from October till March; and the hot, from March till October. The heat is of course greater as we ascend the Nile, and a well-marked change is observed on entering the Thebaïd. In consequence of the clear, unclouded state of the atmosphere the power of the sun's rays is much greater than what we are generally accustomed to in the misty islands of the west, and with this exception the temperate season is much the same as our fine summers. The mean temperatures of the two seasons are—

	Temperate.	Hot.
Delta, . .	50° to 60° Fahr. ...	80° to 90° Fahr.
Cairo, . .	58° " 64° " ...	90° " 100° "
Thebaïd, .	60° " 75° " ...	95° " 110° "

The heat of the temperate season is greatly modified by the northerly winds which prevail during this season, the east being the prevalent wind in the autumn, or, more correctly, in the end of the hot season. In the beginning of the hot season a south-east wind, called the *khamaseen* or *khamsin* (Arab., fifty), from its blowing for fifty days, sets in, and during its continuance the air is filled with dust and particles of sand so fine that they penetrate everything in as well as out of doors. It often raises the thermometer to 110° Fahr. in the shade, and brings on so much disease that the rate of mortality is far higher then than at any other time of the year. The extreme degree of languor, and the suffocating effect it produces, are scarcely supportable, even when it blows in the temperate season, as it occasionally does. It is often erroneously called by Europeans the simoom, for the samiel or howa el simoom is a pestilential wind of the Assyrian desert. *Samiel* or *howa* are both used for wind; *simoom* means poison, and it deserves the name of "the poison wind." The temperature generally falls a good deal during the night, sometimes as much as 30°. Rain and snow occasionally fall in the northern parts of Lower Egypt—at Alexandria pretty frequently; and there are generally, but not always, a few days in the year at Cairo in which rain falls, but snow never. South of this rain is very rare indeed. Fogs are often seen in the mornings, but they soon disappear after sunrise. The plague occurs now and again in the northern parts of Lower Egypt about the Mediterranean, but has not for a long time extended as far as Cairo, although formerly it reached even further south. During the inundation fevers are prevalent, and at the same time ophthalmia is most severe, although not caused by the inundation. Opthalmia is the great scourge of Egypt, but an inquiry into its causes is not suited to this article; the causes generally assigned are, we conceive, quite erroneous. Other plagues of the country are—the flies by day, the mosquitoes at night, and lice at all times. The climate of Egypt, instead of proving injurious, might, with proper precautions, be well borne by Europeans; and if sought at the proper time might be highly beneficial to invalids from this country.

Trade.—The trade is chiefly transit, and 70 per cent. of it is with Great Britain. The total value of the exports and imports is from £30,000,000 to £40,000,000 sterling. Raw cotton is now the only very important item, the value of that exported having varied of late years from £5,000,000 to nearly £14,000,000 sterling. The total exports to Great Britain have varied also from £14,000,000 to £20,000,000 sterling; the value of imports of British produce and manufactures, from £4,000,000 to £9,000,000, cotton goods being the largest item. There are 955 miles of railway open, and 502 are in course of construction. The Suez Canal connects the Mediterranean, at Port Said, to the east of the Delta, with the port of Suez, on the Red Sea. The two seas are on the same level, so that there are no locks; and the canal was filled with salt water from both ends.

People.—The population of Egypt proper is estimated at 5,500,000, or 463 to the square mile, and of these fully 4,000,000 are fellaheen. The townfolk number little more than a tenth of the population, unless the Copts (of whom there are quite 300,000) and Europeans are included. The only large town populations are those of Cairo (350,000) and Alexandria (212,000), which include many foreigners. The number of Europeans in Egypt is about 80,000, of whom half are Greeks, the French and Italians coming next in the census. About 100,000 Bedouins acknowledge the sovereignty of the khedive, and Turks, Negroes, Abyssinians, and other kindred races make up another 100,000. The Jews and Armenians form small but important communities.

The true Egyptians, the vast majority of the modern inhabitants, and almost the sole contributors to the wealth of Egypt, are the peasants or fellaheen, a *fellah* signifying a "cutter," one who cuts or digs the earth. Every operation connected with the cultivation of the soil of Egypt is his sole business and his alone. So far as concerns all that constitutes the wealth of the country, he is the only real worker in Egypt, and has been used to doing all the work from ages long before Moses. His country has undergone many vicissitudes, and has been the spoil of many conquerors in turn, and both his language and his religion have been changed, but the fellah himself remains the same as depicted on the oldest wall-pictures of the tombs and temples. That he is the lineal descendant of the peasants who worked the shadoof to irrigate the land, and scattered the seed in the time of Cheops, the builder of the Great Pyramid, there can be little doubt. Most of these fellaheen dwell in mud-built villages surrounded by palm-trees, on mounds of rising ground which seem to have been formed by the remains of ancient ruined cities. They are miserably poor, having for many years been most unjustly and cruelly treated by the government,

not only with grinding oppressive taxation, but with compulsory tasks of unpaid labour for the khedive's private gain, and with an utter denial of legal protection. The intervention of the British and French governments, and the deposition of Ismail Pasha in 1879, was followed by a great improvement in the condition of these unhappy people; but further reforms, particularly in the ordinary administration of the civil and criminal law, remain to be carried out under the new era which may be said to have commenced in 1883. Personally the fellaheen are a very fine race. Though not tall they are well-built and broad-chested, and their spare lithe frames, which never grow fat, are capable of immense strength and endurance. A great deal of the Egyptian land is the private property of the ruling family, having been appropriated as such by the Khedive Ismail; and of what remains for the fellaheen peasantry, much is alienated from them owing either to their necessity or improvidence in borrowing heavily upon the security of their holdings.

The Copts, who are the Christians of Egypt, closely resemble in outward appearance the Mohammedan Egyptians, only that they dress in darker colours, and generally adopt a black turban. In race they also are direct descendants of the ancient Egyptians, with probably less mixture than the rest of the people. They also preserve in their liturgies the ancient Coptic tongue, the lineal heir of the hieroglyphic language of the monuments. In religion they are members of the Jacobite offshoot of the Greek Church, which separated after the Council of Chalcedon. To have resisted the Hellenizing tendencies of the Greek settlers on the one hand, and the influence of Mussulman persecution on the other, says much for the tenacity with which they have held to their form of Christianity. In order to save their lives and property many did accept the faith of the conqueror, while for those who refused a subordinate position was prescribed; they could never aspire to political equality or equal social consideration with the true believers, and as a visible symbol of this inferiority they were ordered to wear a distinctive costume, and to show in public certain marks of respect to their superiors. Thus isolated the Copts took to occupations which brought them least in contact with the general population. They were scribes, shopmen, handicraftsmen, bankers. Having little opportunity for displaying wealth, they saved it and became affluent. Like the Jews in other countries, they sometimes endured persecution on account of their thrift, and had to purchase toleration by the payment of great ransoms. But this too they survived, and they are to be found at the present day to the number of upwards of 300,000, proud of their descent, exclusive in their ways, and following the callings adopted by their ancestors after the Arab fury first burst upon them. In their capacity as the clerks of Egypt, they enjoy a monopoly of the official transcribing.

History of Ancient Egypt.—There is not the least doubt but that the ancient Egyptians were an Asiatic race. The form of their bodies is perfectly known to us by the numerous mummies, and can be seen in their descendants, the modern fellaheen. That they were not Semitic (or Arab) their language shows (see below); that they were definitely Aryan remains yet to be proved; but that they had not an African origin is certain. They no doubt colonized the country from the Delta southwards, absorbing the aboriginal inhabitants as the English did the Britons. The land was then as now but a strip a few miles wide along the Nile (only about 16,000 square miles in all, with the Delta), and bounded by the desert on each side; but this strip was, even after all allowances have been made for exaggeration, astonishingly fertile and prolific.

Herodotus (B.C. 450) counts 20,000 cities; Diodorus Siculus almost as many; and if villages are reckoned, 30,000—this, too, in B.C. 44. But their population at this time was sparse—not more than 3,000,000—whereas in the palmy times of the eighteenth dynasty 7,000,000 found a home. These 3,000,000 degenerated to only 2,000,000 at the beginning of this century, since which time Egypt has undergone rapid improvement and extension of territory, till now 5,500,000 are counted.

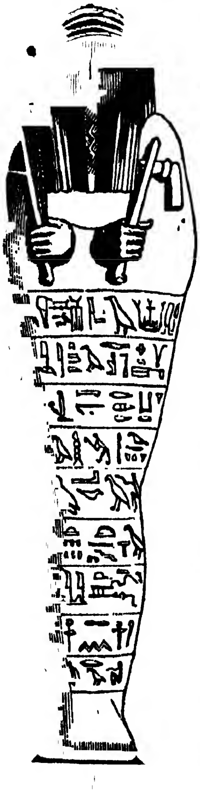
The chronology of ancient Egypt is still not well fixed. It is based upon a catalogue of thirty dynasties, down to the second Persian conquest of Egypt by Artaxerxes III. (340 B.C.) drawn up by Manetho, high-priest of Heliopolis, in the third century. Manetho's work is lost, and has been reconstructed from quotations and abridgments in ancient authors. That of George Syncellus, the Byzantine (800 A.D.), the most modern of these authorities, gives 3552 years as Manetho's sum-total of these thirty dynasties. Although there is nothing to contradict this, there is as yet nothing to confirm it, and everyone is anxious that such important dates should not hang on so slender a thread. The famous "Papyrus of the Kings" (written under the nineteenth dynasty), now preserved at Turin in a very mutilated condition, is yet in other parts of the chronology of great assistance; and though the more the monuments are examined the more difficult it becomes, in the earlier dynasties, to reconcile the various authorities, still from the eighteenth dynasty (1591 B.C.) downwards nearly all the greatest Egyptologists are in substantial accord. The greatest Egyptian scholar, Lepsius, declares for the authenticity of the sentence in Syncellus, and simply adds 3552 to 340, making the first dynasty begin 3892 B.C. M. Mariette, on the other hand, prefers to take Manetho's account of the length of the separate dynasties, which, added together, give more than his own total of 3552. (Possibly, Lepsius justly says, they might occasionally overlap, like our English and Danish kings, &c., and so account for the discrepancy.) In this way M. Mariette fixes the first dynasty as beginning 5004 B.C. Finally, Dr. Brugsch, counting genealogically, and allowing an average time to each reign, arrives at 4400 B.C. as the beginning. Sharpe, Nolan, and some others of less weight reduce this by nearly a half. Many recent discoveries have greatly reinforced Manetho, and the arguments of Lepsius are so weighty that it seems best to adopt his estimate. It will be convenient to copy the table he has finally decided upon as provisionally correct. The dates are those of the beginning of the dynasties:—

1.	B.C.	3892	11.	B.C.	2423	21.	B.C.	1091
2.	"	3639	12.	"	2380	22.	"	961
3.	"	3338	13.	"	2136	23.	"	787
4.	"	3124	14.	"	2167	24.	"	729
5.	"	2840	15.	"	2101	25.	"	716
6.	"	2744	16.	"	1842	26.	"	685
7.	"	2592	17.	"	1684	27.	"	525
8.	"	2522	18.	"	1591	28.	"	404
9.	"	2674	19.	"	1443	29.	"	399
10.	"	2565	20.	"	1269	30.	"	378

As mentioned above, the thirtieth and last dynasty was overthrown by Artaxerxes III. in 340 B.C.

Before the first dynasty, say Manetho and the Turin papyrus, reigned the demigods, before them the gods themselves. Men began the historical period with King Menes of the first dynasty in 3892 B.C. He was of Thinis, near Abydos, in Upper Egypt. He it was who founded the city of Memphis, diverting the stream of the Nile for this purpose, and who adorned it with the great temple of Ptah, and made it the seat of government. The building of the Pyramid of Steps at Sakkarah, a mighty famine, and a great plague are recorded as events of this first dynasty. Egyptian records, unlike the Babylonian and the later Hebrew, bear no trace of a deluge; or perhaps it would be more correct to say that none has yet been discovered. After seven or eight kings the second dynasty

succeeded, its founder being Boethos (3639 B.C.) Kakan, the second king, introduced the worship of the sacred bull Apis, and founded Heliopolis. A later king passed a law admitting women to the sovereignty, a remarkable fact at so early an age. Hitherto Manetho remains almost unsupported, but with Necherophes, the first king of the third or Memphite dynasty (3338 B.C.), monuments and other corroborations begin to occur. Thus, under this king an eclipse is recorded as terminating a war by its influence of terror; under his successors the cultivation of letters and building with hewn stones took so large a development as to be almost new arts. Still more in the succeeding reigns were these things brought to perfection, and yet remain to tell their tale. The era of pyramid-building began with the last kings of the third dynasty, they who also carved the SPHINX; but Khufu, whom Manetho calls Suphis and we call Cheops, the first king of the fourth dynasty (3124 B.C.), eclipsed all previous and indeed all succeeding efforts by the Great Pyramid, still rearing its huge mass at Gizeh, the wonder of all ages. [See PYRAMIDS.] The absolute control of the kings over the people to force them to build these extraordinary royal tombs almost passes belief, were it not that we know these early Pharaohs to have been, like the later Roman emperors, objects of worship. Khufu was worshipped about 600 B.C. The successor of Khufu was Khafra, whom we call Khafren (or Cephren), and his splendid sepulchre is the second of the great Gizeh pyramids. The third is that of Khafra's successor Menkaura (or Mycerinos), under whom the famous "Book of Ritual" was completed, one of the most valuable of all early records. Statues of Khafra and the portrait mummy-case of Menkaura still exist. Royal and noble persons built noble sepulchres near by, and it is said that the Sphinx himself is only one of a colossal avenue! so mighty was the power and so great the splendour of this time. (It is noteworthy that while the Greek Sphinx is feminine her brother of Egypt is masculine.) The fifth dynasty was also Memphite, some of its great works being the Abouseir pyramids, and seems a continuation of the fourth; but the sixth dynasty (2744 B.C.) marks a new departure. Under Pepi great wars are undertaken, the neighbouring lands are brought into subjection, many monuments, though of less careful and beautiful work than before, cover the land. Pepi's pyramid is at Darshoor, and if it is true that he reigned 100 years, he certainly earned well his repose. The last monarch of the sixth dynasty was Queen Nitocris, whose beauty is famed throughout these most ancient records. She was buried in the third Gizeh pyramid, that built by Menkaura, which she remodelled and faced with red syenite in a most splendid manner, as we trace to this day.



Shabti, or Sepulchral Figure, of brightly coloured glazed pottery, from an Egyptian tomb.

The wealth of remains, of which only a very little has been spoken of above, which has assisted historians of the fourth, fifth, and sixth dynasties now fails, and almost nothing but Manetho's catalogue remains till the twelfth dynasty, begun by Amenemhat I. in 2380 B.C. The tombs of Beni Hassan contain an almost complete memoir of the first five kings of the new dynasty on their walls. Everything is there depicted flourishing and prosperous, evidently the golden epoch of the pyramid-builders has again been equalled if not surpassed. Of this age are the obelisk of Heliopolis and the temple of Amun-Ra at Thebes. Thebes, not Memphis, is now the capital.

A stelé or funeral inscription of a grand-minister or vizier of Usurtesen I. son of Amenemhat I., named Mentuhotep, records conquests in Asia and in the Soudan. Under a later king, Usurtesen II., the records show us 36 "Amu," evidently Semitics, arriving at the royal court. By their features, dress, &c., the conjecture has been made that they were Jacob and his sons and attendants; but it is more likely that Joseph held power under one of the Hyksos or Shepherd kings of the seventeenth dynasty. [See JOSEPH.] The attributes of Mentuhotep, spoken of above, are, however, practically identical with those recorded of Joseph in the Bible, the whole executive power being concentrated in his hand, and the nobles bowing before him. Later still comes another Amenemhat, the third of the name, who is famous for his gigantic works. He dug out a vast artificial lake, Lake Mœris, to receive and store the surplus Nile water, that afterwards therewith the country might be irrigated. This valuable work was allowed to sink into decay, and its true site was only clearly traced quite recently by M. Linant. On its shores the same king built the famous Labyrinth, a colossal building with 6000 rooms, the remains of which M. Lepsius had the honour of discovering. This enormous edifice was the meeting-place of the periodical assemblage of local parliaments, and as each had its separate set of apartments their number becomes intelligible. Near by, this great king built a small pyramid for his tomb, no longer wasting in the wish for immortality the whole resources of the country on his burial-place, as Khufu and his successors had done at Gizeh, but expending them wisely in noble and useful works. At the close of this noble Theban dynasty, during which Egypt reached its highest prosperity and power, the monuments again fail us. The thirteenth dynasty ruled at Thebes, the fourteenth from the Delta. Many historians conjecture that they were contemporaneous sovereigns of Upper and Lower Egypt. The Egyptian sovereigns were now overthrown (B.C. 2101) by an invasion and conquest, their conquerors being vaguely styled Hyksos or Shepherds. The fifteenth and sixteenth dynasties were of these barbarians, occupying the same relation to the polished cultured Egyptians as the rude Goths to the Romans of the empire. They came from the East, and seem to have been Arabs. They ruled from Memphis, all Egypt being cut up into tributary provinces. After about 500 years of their sway the Egyptians rose against them and drove them out. They went through the desert to Judea, says Josephus, quoting (or asserting that he quotes) Manetho, and founded Jerusalem; but this is a manifest attempt to account for the Exodus, and being quite unsupported seems suspicious. The seventeenth, a Theban dynasty, was of subkings tributary to the Hyksos. These Shepherd kings are most interesting to us, for it was under their first dynasty that Abraham sojourned in the land of Egypt; and it was under their second (the sixteenth), in B.C. 1806, that Joseph, the son of Israel, interpreted his dream to the Pharaoh, the Hyksos king, Sutapepe Nubti, which led to his great fortune, and to the whole story culminating in the Exodus.

Aahmes (Amosis), king of Thebes, led the revolt; and as his reward became (B.C. 1591) the founder of a new dynasty, the eighteenth. The two succeeding dynasties are often called the Empire. They represent the highest

pitch of power and luxury attained by the Pharaohs. The empire became rapidly military. The state, though probably less really rich and prosperous than under the great Amenemhat, became more splendid than ever before. Conquest succeeded conquest, and the victories were now made sources of gain. Every means of luxury was sought. Horses are frequent in the bas-reliefs; great officials of state exercise the most arbitrary power, and with the soldiers and priests burden while they glorify the empire. Though its monuments are not so solid as those of the fourth (pyramid-builders) and the twelfth dynasties they are more pretentious and numerous. The temples now became magnificent and vast, tombs are frescoed in glowing colours with the histories of the nobles who rested in them. Hardly ever was such a display of magnificence in the world. The dances, concerts, and feastings depicted on the walls show every mark of the greatest refinement and lavish costliness. Aahmes had gained a certain power over Ethiopia by a marriage with a princess of that country. His son Amenhotep I. (Amenophis), feeling secure in the south, carried his arms eastward, annexing Phœnicia and part of Syria. The captives he made were employed in decorating the great public monuments, notably the temple of Amun-Ra at Thebes. His successor Thothmes I. shared the throne with his daughter Hatshepu, an ambitious and powerful monarch, who seems only to have regretted her sex, for towards the end of her reign she delighted to appear in male garb. She seems to have married her own brother, and to have reigned a second time with him (as Thothmes II.); and she took a third lease of power after her brother-husband's death as regent during the youth of a much younger brother, who afterwards became Thothmes III. Both the obelisks at Thebes are of her erection, or to be precise, bear her name. She ruled with a rod of iron; nothing was too hard for her. She built a fleet and harried the whole coast line of Arabia, perhaps of Persia. The monuments show her triumphant return with all kinds of spoil, including some spice-trees, which she is depicted as planting at Thebes. Under her masculine guidance her young charge Thothmes III. grew into a great monarch. He was ungrateful enough to substitute his own for his sister's name on most of her monuments, but that now became a common practice with the Pharaohs. To forge a name is certainly much quicker than to build a temple or quarry and transport an obelisk. As soon as Hatshepu was dead Thothmes launched out in a great career of conquest. His victory at Megiddo, the key of the Euphrates district, brought Syria and Mesopotamia to his feet, so that not only Ethiopia and the south, but Assyria, Phœnicia, and Syria, and far inland to the eastward in the continent of Asia, paid him tribute. The islands of the Mediterranean acknowledged him lord, and paid him tribute. Amenhotep III. (Amenophis), a later king, built some of the grandest works in Egypt. The two temples at Thebes are his, one on either side of the Nile. The western one must have been a wonderful building, judging by what remains. The colossal statues (one of which is known as the vocal Memnon) formed part of its entrance. His tomb lay beyond. His marriage with a foreign queen (probably Indian) brought disastrous results, for Amenhotep IV., son of this union, forsook the gods of his fathers and worshipped the sun. All Egypt was turned to the new faith. This king and many of his followers present the most marked difference in their appearance to the ancient Egyptian type; they are thin to emaciation and very ugly. Three heretic kings succeeded, but Haremheb (Horus), the last of the dynasty, restored the old faith and demolished the new temples. Haremheb left no successor, and the new dynasty was begun by Ramses, a descendant of the Hyksos, and a powerful chief of Lower Egypt. Ramses and his long line of successors were therefore probably as much foreigners and as perfectly the masters as our own Norman kings.

The nineteenth dynasty began with Ramses I. in 1443, and soon arrived at a pitch of great splendour. The second monarch Seti (Sethos) found the empire narrowed from its huge dimensions under Thothmes III.; but rather than seek to extend it he judiciously made it secure by a succession of splendid victories, and by founding permanent Egyptian garrisons along the line of the eastern frontier. At home, too, he shone as the builder of the magnificent Karnak, whose north wall bears the record of his conquests. His fine excavated rock-tomb at Biban-el-Muluk is one of the most beautiful of Egyptian monuments of the kind. Seti married the heiress of the older dynasty; his son Ramses II. (or "the Great") was therefore the legitimate sovereign, as well as the *de facto* ruler. Ramses II. is the grandest figure in Egyptian history—the best known to us also. He ascended the throne when a young man, and reigned sixty-seven years, dying about the age of ninety-six, or possibly more. He married thrice, and had twenty-three sons and about half as many daughters; but by the children of his concubines his progeny altogether amounted to the large number of 170, 111 of whom were sons. Ramses fought one great war at the beginning of his reign with the Syrians, ending in his taking Jerusalem and other cities. The rest of his long reign was devoted to the peaceful ruling of his country, and to never-ceasing building of those splendid monuments throughout Egypt and Nubia which have made his name so well known to us. Ramses the Great is now usually considered as the Pharaoh of the oppression of the Israelites preceding the Exodus. The mummy of this great king and that of the great warrior-king Thothmes III. were discovered in July, 1881, in the royal tombs at Dayr-el-Baharee, near Thebes, a fact which caused much excitement and interest at the time. He gives the historic basis for the legendary Sesostris of the Greeks. The latter part of the nineteenth dynasty was a period of confusion, the successors of Ramses II. not having been able to hold together his great empire. Probably the Exodus occurred towards the close of the reign of the Syrian usurper Arisu, who closes the nineteenth dynasty, according to Lepsius' calculation. The calculation of Usher is so very faulty as to be valueless, the chief date—the building of the second temple—being manifestly wrong by a century. Lepsius is well supported by Egyptian records, and the result of his investigation fixes the date of the Exodus of the Israelites at about 1314 B.C. M. Mariette would make it B.C. 1336. In either case the Exodus was after the death of Ramses the Great; but many Egyptologists seek to fix the stigma of the oppression of the Israelites upon that great king. It seems unlike all we know of him, and the evidence as yet does not warrant the conjecture. There is no Egyptian record of the Exodus nor of the passage of the Red Sea. After the nineteenth dynasty the "Aperiu" (Hebrews) are no longer recorded as a branch of the public slaves in Egyptian monumental inscriptions.

Set-nekht, of the old royal line, overthrew the usurper, and founded the twentieth dynasty, B.C. 1269. Egypt was now in full decline—all her foreign possessions gone, and only a Ramses II. or such firm ruler able even to keep the land itself in order. A violent struggle with the priesthood for supremacy of power closed this dynasty, B.C. 1091. It was succeeded by the Tanite dynasty (twenty-first), the daughter of whose last king married Solomon, taking as a dowry the town of Gezer in Canaan, which her father had conquered. The twenty-second dynasty were foreigners, Semite, probably Phœnician, in origin—crowding the language with Semite terms, finally crushing the priesthood, and assuming it for themselves as a hereditary kingly office. Sheshonk was the first monarch of the new (twenty-second) dynasty, ascending the throne B.C. 961. He is the Shishak of the Bible. He received the refugee Jeroboam, and later on marched against Rehoboam with 12,000

chariots and 60,000 horsemen when the ten tribes revolted, took and plundered the Temple (B.C. 948), as is recorded in the Bible (1 Kings xiv. 25; 2 Chron. xii. 9). The next dynasty showed merely a change of family, and the next (twenty-fourth) was limited to one reign, that of Bocchoris, B.C. 729-716. He was deposed and killed by the Ethiopian invader Shabak, who founded the twenty-fifth dynasty. Hoshea, king of Israel, sent presents to Shabak, and the latter joined in the conspiracy against Sargon of Assyria which cost Israel its liberty (2 Kings xv., xvii.) Shabak got off with the loss of the Delta and Lower Egypt. Shabatok his successor joined king Hezekiah of Judah in a fresh conspiracy. Sennacherib, the new king of Assyria, marched against the confederates (2 Kings xviii., xix.), and the tradition of the Egyptians fully confirms the splendidly dramatic account in the Bible of Sennacherib's discomfiture and death. Esarhaddon, successor of Sennacherib, subdued the remnant of Egypt entirely, and cut up the whole country into satrapies, held by Assyrian troops. Egypt from time to time revolted, but was always again brought under the yoke. Gradually, however, as Nineveh declined Egypt revived, and Psammetik (Psammetichus) was able in 685 B.C. to found the twenty-sixth dynasty. He was a native Egyptian prince, and strengthened his tenure of the throne by marrying a niece of Shabak. This was the prince who threw open Egypt to the Greeks; and soon Thales, Solon, and Pythagoras were able to found Greek philosophy and polity upon the basis of what they found in Egypt. Neku II., B.C. 611, son of Psammetichus is the Pharaoh-nechoh of 2 Kings xxiii. 29, by whose invasion Josiah, king of Judah, met his overthrow and death. He was a brilliant warrior, but his many reconquests of old imperial territory could not be held by his successors. In 571 Nebuchadnezzar, king of Babylon, conquered Egypt, but on his death Amasis or Aahmes, with Greek help, reconstructed the kingdom and even extended it, taking Cyprus, allying himself with Crœsus of Lydia against the growing power of the Persians, &c. But on the death of the excellent Amasis, the sceptre fell to the feeble hand of Psammenitus, and Cambyses of Persia saw his opportunity. Hastily invading the country he defeated Psammenitus at Pelusium, and Egypt became an appanage of Persia, B.C. 525 (twenty-seventh or Persian dynasty). There is no doubt but that Cambyses was mad; he insulted the Egyptians, slew their sacred Aphis, defiled their temples, &c. He ruled with a rod of terror. Not so Darius II. of Persia, his successor, who was a good king to Egypt, opening a canal from the Nile to the Red Sea, &c. At his death the Egyptian Amyrtæus reigned B.C. 404–399 as the solitary king of the twenty-eighth dynasty. The Mendesian or twenty-ninth and thirtieth dynasties followed B.C. 399 and 378. Agesilaus of Sparta, in Greece, served under the last dynasty as a mercenary with his troops, and assisted the insurrection which placed Nekht-nebf II. (Nectanebes), the last native king of Egypt, on the throne. In B.C. 340 Artaxerxes III. (Ochus) of Persia determined to regain Egypt, and himself heading the expedition, carried everything before him. Nectanebes fled to Ethiopia, and the long line of the Pharaohs had ended for ever. From B.C. 3892 (Meno's accession) to B.C. 340 (Nectanebes' flight) is over 3550 years. But during all the twenty succeeding centuries Egypt has never for a moment had a native prince, a remark which certainly brings a lurid light to bear upon the prophetic passage in Ezekiel xxx. 13. The land was horribly treated by the Persians: but it soon had a liberator in the person of Alexander the Great. The Macedonian conquest was a real benefit to the distracted country. Alexandria arose, Greek learning restored to Egypt a thousandfold what she had before received, and the long succession of the PTOLEMIES filled the next three centuries, as described in the article devoted to those princes. It must be remembered that the Ptolemies were purely Macedonian Greeks, and that Cleopatra was in nowise an Egyptian princess, except as we speak of some distinguished English soldier as an Indian general if he has served in India.

The fall of Cleopatra turned Egypt into a Roman province, B.C. 30, and it was henceforth governed in a purely military way, though not by men of the highest or senatorial rank. One of the equestrian order was held noble enough for poor Egypt. Its history, as might be expected under such chilling influence, presents scarcely any features worthy of record. Caligula murdered the youthful Ptolemy, grandson of Cleopatra, A.D. 40, and extinguished the line for ever.

Egypt was early converted to Christianity. The great outburst of the Arian heresy took place in Egypt at Alexandria (see ARIUS, ATHANASIUS), during which the Council of Nice was called at Nicæa in Bithynia, A.D. 325; and later on the DONATISTS rose to their great power in the fifth century.

See Lepsius on the Turin Papyrus (Leipzig, 1842); "Königsbuch der alten Ægypter" (Berlin, 1858); Brugsch, Eng. trans. "Egypt under the Pharaohs" (London, 1879); Sir Gardner Wilkinson's "Egypt," edited by Birch (London, 1878); Rhoné, "Resumé Chronologique" (Paris, 1877); Mariette, "Monuments of Upper Egypt" (Cairo, 1877).

Religion of Ancient Egypt.—This yet remains a perplexing problem. We know from the Greeks and Romans that Egypt was the source and home of the most abstruse speculations of the ancient world, but we are confronted with a gross material polytheism on every side in the monuments. The fact seems to be that as the images of saints, &c., sometimes lead to idolatry among the ignorant of our own Roman Catholics, while the faith of their better taught fellow worshippers remains pure, so in Egypt a high doctrine of trinitarian monotheism was taught among the learned and the priests themselves, though translated into various gods and images of gods for the vulgar. M. de Rougé has in the minds of most Egyptologists conclusively proved from the papyri that the true faith of Egypt regarded the Deity as triune—father, mother, and child, the father and mother being one person and the child another. This idea degenerated into that of local triads of gods, as *Osiris*, *Isis*, and their son *Horus*, &c. The eighteenth dynasty, as has been shown, endeavoured to crystallize this worship of one god into sun worship, and for a few generations succeeded, but the land then reverted to its old faith. Nevertheless *Ra*, the sun-god (not the sun itself), always was the principal object of worship, and was regarded as a type of the supreme Deity. *Mentu* and *Atmu* were the sun-rising and sun-setting, or principles of the upper and lower world. A curious conception is that of *Seth*, the destroyer, opponent of Osiris—a power of necessary evil, in nowise malevolent. The worship of Seth was prohibited from the twenty-first dynasty onwards by a mistaken confusion similar to that which occurred in Hebrew religion, giving rise to our modern idea of a devil. *Amun* or *Amen*, the hidden, *i.e.* universal mind, came generally to be regarded as one side of *Ra*, and mental and physical powers were thus expressed in the joint name *Amen-Ra*, the head of the Theban pantheon and chief of the Theban principal triad, Amen-Ra, Mut, and Khuns, their son. *Ptah* (the opener) was especially the head of the Memphis pantheon, and is merely a personification of intellectual power and creative force.

It is necessary in the briefest manner to enumerate the chief gods of Egypt and their forms, Osiris and Isis alone requiring special articles on account of their importance. *Osiris*, the good principle, usually represented as a mummy. *Apis*, the sacred bull, was worshipped as the living emblem of Osiris. *Isis*, the material principle, a veiled woman, a throne or horns on her head. *Ra*, creator and sun-god, a hawk-headed man, the sun-disc on his head; or as

Amen-Ra, with a human face. *Shu*, light, a human form with an ostrich feather; *Tefnet*, his consort, lioness-headed. *Seth*, principle of impartial evil, has a snouted face and large high ears. *Ptah*, the opener, creative and developing force, is often represented as a pigmy, or an embryo in the act of development. *Seb* and *Nut*, parents of Osiris, have human forms. *Sebek* is crocodile-headed. The above are the nine chief gods. Of the rest, *Anubis*, the jackal-headed god, son of Osiris, and prayed to as a mediator therefore, is a frequent object; as is *Knum* (Chnuphis), the ram-headed god, soul of the world. *Neith*, whence some have derived the name of Athena (a-then-a, the Egyptian nēth being read backwards of course), was human in form, wearing the Lower-Egypt crown, and having the attributes of the Greek Athena. *Pasht* or Bast (goddess-supreme at Bu-bast-is, her own town) is a cat-headed deity, with the attributes of the Greek Artemis. The Memphis triad was Ptah, Pasht, and their son Imhotep, the latter god of science, somewhat as the Greek Æsculapius. *Khuns*, the moon god, wears on his head the lunar crescent.

Language of Ancient Egypt.—The language of ancient Egypt has been deciphered in our own day, after being utterly lost for over 2000 years, by help of the Coptic, its much debased descendant. It is now regarded as the chief of a group of dialects known as the HAMITIC, as if from Ham, son of Noah. (So also the Arabic is the chief *Semitic* tongue, as if from Shem, son of Noah.) The Coptic Christian records date back, in a character derived from the Greek, almost to apostolic times. The Greek-like Coptic character drove out the ancient Demotic character at the time of the introduction of Christianity. It is still existent, but only as a dead language used in religious services. Arabic has quite superseded it. The services are understood by means of interleaved Arabic translations, much as the Latin Roman Catholic services are rendered intelligible to the poor among ourselves. It was in full use in the ninth century, and still intelligible in Middle Egypt in the twelfth century; surviving, though rapidly dying out, till the seventeenth century, the last man known to speak it having died in 1663. Egyptian seems to have degenerated towards Coptic about the seventh century B.C. The Ptolemies (Greeks) introduced many Greek words.

Both Coptic and ancient Egyptian are of the utmost simplicity of structure, so much so that the language seems all roots. Inflections are almost absent, parts of speech are hardly to be distinguished. Thus *ran-i* means "name me," and according to the context does duty for "my name" or for "I call," &c. A few auxiliaries mark moods and tenses. The noun is not declined. The article and pronouns distinguish masculine from feminine usually. Great efforts have been made to connect this most primitive of tongues with the complex Semitic, hitherto with the scantiest results, not to say failure. But the Libyan or Berber and the Ethiopian languages of to-day are evidently derivations of the ancient Egyptian.

The Egyptians wrote on their public monuments in HIEROGLYPHICS, which was modified into the current *Hieratic* of the papyri; and the latter, still further simplified for common purposes, became the *Demotic* writing.

Modern History.—Passing over the ages during which Egypt was a province of the Roman Empire, we begin the modern history of Egypt at the Mohammedan conquest. Under the caliphate of Omar, Amer ebn el As invaded Egypt, A.D. 638, and the whole of Egypt as far as Assouan was soon reduced to a province of the caliphate, the capital of which was Fostat. In 868 Ahmed ebn e' Tonloon, governor of Egypt for the Abbaside caliphs, usurped the sovereignty of the country and founded the dynasty of the Thonlounides, which lasted till 906, when the caliphs retook Egypt. Two further usurpations and reconquests took place before the year 970, when the Fatimeh or Fatemides took possession of Egypt. El Moez, who styled himself Caliph, built Misr el Kahirah (Cairo), where he fixed his residence. From that time till 1171, the Fatemide caliphs reigned over Egypt, independent of and rivals to the Abbaside caliphs of Bagdad. The Kurd Salah e' Deen Yoosef ebn Eyoob succeeded to the Fatemides in 1171, and founded the dynasty of the Eyoobites, which lasted till 1250. Then succeeded the Baharite dynasty, from 1250 till 1261, when the Mamaluke Baybers made himself sultan of Egypt, put an end to the caliphate of Asia, and extended his conquests as far as and over part of Armenia. His descendants reigned till 1382, maintained possession of Syria as far as the Euphrates, and encouraged agriculture and the arts. In 1382 Dowlet el Memeleek el Borgéēh, a Circassian slave, took possession of the throne, and founded the dynasty of the Borgéēh or Circassian Mamalukes, which lasted till 1517, when Selim I., the Ottoman sultan, conquered Egypt. He established a sort of Mamaluke republic or rather aristocracy, consisting of twenty-four beys or governors, under a pasha at Cairo; the whole subject to the sultan. This government lasted till 1798, but with frequent attempts on the part of the Mamalukes to shake off the Turkish supremacy. Bonaparte took and held the country from 1798 to 1801, when the English conquered and restored it to its former owner. Mehemet Ali, who was pasha in 1811, put an end to the Mamaluke dynasty by slaughtering nearly the whole of the beys in that year. In 1819 he undertook the conquest of the Soudan, the vast country southwards from Assouan to the equator (1650 miles), and from the Red Sea towards the Libyan Desert for some 1300 miles. His object may have been to extend trade, to find gold, and to conquer territory; but the actual result was a continual drain on the resources of Egypt. From the time of Mehemet Ali onwards the Soudan swallowed up whole armies, opened a wider field to the slave-trade in its worst form, and contributed to impoverish and exhaust Egypt. The country remained till 1849 under the rule of this extraordinary man, who threw off the supremacy of Turkey, and introduced many European arts and customs into Egypt. He was succeeded by his grandson, Abbâs Pasha, but his short reign, which gave repose at least to Egypt, terminated in 1854, when Said Pasha succeeded to the government. This monarch died on 18th January, 1863, and was followed by Ismail Pasha, the eldest surviving son of Ibrahim Pasha, eldest son of Mehemet Ali. Ismail Pasha, as will be explained further on, was deposed in 1879 in favour of his son, Mohammed Tewfik.

Under the rule of the late khedive, Ismail Pasha, Egypt underwent a wonderful, and, as it proved, a rather embarrassing transformation. It was during his reign, and mainly by his encouragement and financial support, that the Suez Canal was opened—a work investing Egypt with new political and commercial importance as the chief highway for British and European trade with India and the south-eastern hemisphere. About 1200 miles of railway were also opened, and postal and telegraphic communications over the whole country were organized. Irrigation works were extended, and 350,000 acres were added to the area under cultivation. Large sugar factories were erected, with the most modern appliances, and more than 100,000 acres were planted with the cane. Cotton cultivation was also encouraged. Ports, harbours, and lighthouses were constructed, and the harbour, breakwater, and jetties of Alexandria, completed in 1875 at a cost of £1,500,000, form one of the most splendid works of its kind in the world. Paper-works, gas-works, and water-works were also erected. Expeditions for the suppression of slavery were undertaken in the Soudan, under the command of Sir S. Baker, in 1873, and under Colonel Gordon in 1876, in Senaar and Kordofan in 1874, and Darfur in 1875; and resulted in the addition of a large territory and of nearly 18,000,000 of subjects to the khedive's nominal

sway. Cairo itself was transformed; new streets—well paved, lighted, and watered—and handsome houses were built in well-planned boulevards, and new roads and bridges were constructed.

Egypt, however, was not prepared for such vast enterprises, and the endeavours of the khedive to adopt the most advanced features of western civilization were hasty and inconsiderate. To carry them out vast financial operations were necessary; and in the absence of an honest and enlightened administration and of an effective control over the revenue and expenditure of the country, Egypt became a prey to boundless intrigue, extravagance, and peculation.

In the middle of this, in 1875, came the Turkish financial collapse, dragging down with it Egyptian credit. The khedive had drifted into a state of heavy debt, and ineffectual struggles to free himself only filled the usurers' pockets. Finally, in April, 1876, the Egyptian government postponed all payments for three months to obtain time to seek a decent way out of the difficulties of impecuniosity and importunate creditors. In the previous year the British government had purchased the khedive's Suez Canal shares, and the khedive had engaged to pay to England interest for the sum received for them for a certain time, until the shares were eligible for dividends from the canal company. The Hon. Stephen Cave was now sent out by the British government to investigate the state of Egyptian finance and debt, and to see, under the critical circumstances, what were the prospects of the khedive being able to pay to England the sum of nearly £200,000 per annum now due. Mr. Cave reported favourably as to the ability of the khedive to pay, provided there existed a firm and just administration, and a thorough and honest control over Egyptian finance.

Unfortunately, however, as was well known, these were precisely the things which did *not* exist in Egypt, and hence the failure to meet his engagements, whereby the khedive had lost the sympathy of Europe, and had forfeited his credit on European exchanges. In May, 1876, a scheme was devised which it was thought would meet the case, but it failed to satisfy any creditors, and grumbling only grew louder. Mr. Goschen, on the part of English creditors, and M. Joubert, for those of France, were then deputed to confer with the khedive and make the best possible arrangement with him. After very extensive inquiries they came to the conclusion that the actual amount of Egyptian annual revenue might be put at £10,500,000, and the khedive entered into an agreement that of this sum only £4,500,000 should be taken for state purposes, leaving £6,000,000 annually to meet payments on account of debt.

Mr. Goschen and M. Joubert saw, however, that such an agreement with a shifty Oriental prince in straitened circumstances would be worth little, and that the only thing that would satisfy Europe was the administration of the revenue by Europeans in the sole interest of creditors. It was a tremendous concession to ask from a ruler whose whole life had been passed in all the traditions of despotism and irresponsible rule. The sacrifice, however, was made, and Europeans of the highest administrative reputation in their own country, whether England or France, were appointed as controllers of Egyptian finance in the interest of the creditors, and a ministry was subsequently formed, in which the two most important positions were given to an Englishman and a Frenchman—Mr. Rivers Wilson and M. de Blignières. At the same time gentlemen from the British departments of inland revenue, customs, and post office were appointed to the highest positions in the corresponding departments of Egyptian revenue. Such concessions appeared valuable, but their worth depended, of course, on the integrity and good faith of the khedive, to whom all these alien collectors and administrators were primarily responsible; and early in 1879 he summarily dismissed his able European advisers, and appointed a purely Egyptian ministry. Ultimately England entered into concert with France with a view to the better administration of the country, and a reprimand, couched in the strongest language, was presented to the khedive. No notice, however, was taken of it, and thereupon the sultan, disregarding the obligations of the international settlement of the Egyptian pashalic, usurped an authority to interfere with it, and deposed Ismail Pasha, and appointed his son, Tewfik Pasha, in his stead. The new khedive agreed to accept at the hands of the European powers either a new set of European ministers, or a renewal of the control established by the Goschen decree. The rate of interest of the verified debt was a matter of contract settled by that decree, and the khedive alone could not change it. After consultation the powers decided to re-establish the control, and Major Baring and M. Blignières were appointed to carry it out. The investigation made by these gentlemen showed that the Egyptian revenue was only about £8,500,000 per annum, and they recommended in 1880 that certain portions of the debt should be written off, and interest at 4 per cent. accepted for the remainder, about £74,000,000. Major Baring and M. Blignières considered this was all that Egypt could pay, and the compromise was accepted by the creditors. Thus relieved of financial embarrassment, and with the advantage of an honest and economical government, a better future seemed to be before the country.

The prospect, however, was delusive. The repeated interference of European powers, the monopoly of most of the leading positions by European officials, and the oppressive taxation to pay interest to European bondholders, all tended to stimulate the growth of a so-called national party, eager for the expulsion of all foreigners, and for the possession of "Egypt for the Egyptians." At the head of this party was Arabi Bey, a native Egyptian of unusual ability and ambition. The army sided with the movement, which assumed such threatening proportions that England and France joined in a note expressing their united determination to maintain the khedive's authority. It soon became apparent, however, that France did not mean to interfere more than by diplomatic notes, and, in the belief that England would not act alone, Arabi and the military party openly defied both Europe and the khedive. On the 11th June, 1882, a street brawl in Alexandria between a Maltese and an Arab gave the signal for a Mussulman rising, undoubtedly preconcerted, in which the rioters assaulted, wounded, and killed a great number of Europeans, and pillaged their houses—the British consul being among those who were very seriously injured. Dervish Pasha had already been sent from Constantinople to Egypt, avowedly to support the khedive, but on finding the rebel cause to be considerably the strongest the sultan decorated Arabi for his exemplary conduct, and conferred on him the highest class of the Medjidie order. The sultan further explained to Arabi that the khedive was of no account in his eyes, and might be any day superseded by a good Mussulman who knew how to baffle the foreigner and infidel. Arabi Pasha was at this time minister of war, but England and France now joined in a note demanding the dismissal of the ministry and the exile of Arabi. The khedive accepted this ultimatum and the ministry resigned, but the military party were masters of the situation, and the unfortunate khedive had to undergo the bitter humiliation of recalling a minister who was already practically the head of a powerful rebellion. The ambassadors of the various powers met in conference at Constantinople, and urged the sultan to put down the insurrection; but the sultan would neither take part in the conference nor send troops to Egypt, where, he stated, everything had been settled to his complete satisfaction. Then England announced that if no one else would act she would. Together with France she

had already sent men-of-war to Alexandria, but immediately on active measures being threatened the French ships were withdrawn. France had plainly shown her determination not to interfere, and M. de Freycinet, upon proposing a small vote of credit for a very limited intervention, was turned out of office. At Alexandria Arabi was fast throwing up defensive works and arming the forts, in spite of the protest of the British admiral. On the 11th July, therefore, our fleet opened fire; the forts, after a spirited defence, were silenced, and Arabi's army was withdrawn under the false cover of a flag of truce, setting fire to the European quarter of the town as they left, and thus reducing to ruins some of the finest parts of the city.

The most vigorous steps were now taken by the British government to suppress the military revolt. The reserves were called out, a vote of credit taken, an Indian contingent was ordered to leave for Egypt, and a large force was despatched from England under Sir Garnet Wolseley. After several preliminary engagements, the British forces confronted Arabi and his army on the direct road from Ismailia to Cairo, at Tel-el-Kebir, which had been strongly intrenched and prepared for defence by extemporized earthworks, &c. The dispositions of the British commander were cleverly made, and all being ready he resolved to attack the enemy on the morning of Wednesday, 13th September. A night march, boldly planned and most skilfully executed, brought the English troops to the enemy's position at daybreak; without firing a shot the men rushed to the intrenchments, carried them at the point of the bayonet, and in half an hour all was over. Arabi fled to Cairo, his army broke up, a forced march of the Indian contingent saved Zagazig, and by a still more brilliant improvement of victory General Drury Lowe hurried his cavalry to Cairo, saved the capital from the fate of Alexandria, received the submission of the garrison of the citadel, and captured Arabi. As soon as the news of Tel-el-Kebir reached Kafr Dowar, the Egyptian force there surrendered to Sir Evelyn Wood, and this was followed, after a short delay, by the submission of the garrisons of Aboukir and Damietta. The khedive returned to Cairo, and the war was at an end.

Arabi Pasha was placed upon his trial, and but for the interference of the British government on behalf of this singular rebel, he would speedily have been executed. As it was, the sentence of death was commuted to banishment, and he was deported to Ceylon. Of Sir Garnet Wolseley's gallant force the majority returned home, but about 10,000 men, under Sir Evelyn Wood, were ordered to remain until the country had become somewhat settled, and a just and stable government had been insured to it. For the time, at any rate, Egypt became a British colony in all but the name.

One of the first announcements of Earl Granville, after the suppression of Arabi's rebellion, was that this country would not re-establish the Dual Control. With this understanding, Lord Dufferin, assisted by a number of able Englishmen, proceeded to elaborate a scheme of administrative and social reform, including the germs of a national representative system. These recommendations, set forth in a remarkable despatch laid before Parliament in the spring, were adopted without demur by the khedive, and things began to assume an encouraging aspect. It was apparently agreed on all hands that though Egypt was to be educated for self-government, it was impossible for the present to dispense with British predominance or to withdraw British troops. The changes in administration, in the judiciary, and the army, as well as the development of political institutions, must be necessarily slow. Sir Evelyn Wood had undertaken the organization of the army, and Baker Pasha that of the gendarmerie. Sir Auckland Colvin became financial adviser to the khedive, but was succeeded not long afterwards by Mr. Vincent, while the post of consul-general was filled, with increased powers and dignity, by Sir Evelyn Baring, previously financial member of council at Calcutta. The Bedouins who, during the revolt, had murdered Professor Palmer, Lieutenant Gill, and their companions, were brought to justice in January, 1883, and some months later the authors of the Alexandria conflagrations were convicted and punished. The country, under British guidance, was progressing, though indeed slowly, and in spite of some outcry at the cholera epidemic in the summer the acquiescence of Europe was still indisputable. But the withdrawal of the British troops was loudly called for by many leading politicians in this country, and in November, 1883, at the Lord Mayor's banquet, it was announced by the prime minister that their number would be largely reduced. But before this order could be carried out, an unexpected catastrophe in the Soudan enforced a reversal of policy.

The vast region known as the Soudan, or "country of the blacks," extending over an area larger than India, had been seized and occupied by Egypt at various periods from Mehemet Ali's first expedition in 1819 to that of Sir Samuel Baker in 1873. Over the enormous country thus annexed, reaching some 1600 miles southwards to the lake sources of the Nile, and about 1300 east and west, a number of Turkish and Circassian pashas were appointed to rule. Separated by wide-stretching deserts from the Cairo authorities, the pashas and Egyptian garrisons had things pretty much their own way, and soon earned an infamous notoriety for rapacity and oppression of the Soudanese. In 1877 Colonel Gordon—known for his suppression of the Tai-ping rebellion as "Chinese" Gordon—became governor-general of the Soudan, where he established a system of just and equitable government, which led, after his departure, to a revolt against the revived misgovernment of Egyptian officials. By treating the people justly, by listening attentively to all their grievances, and mercilessly repressing all those who defied the law, he accustomed the people to a much higher standard of government than any that had prevailed in those regions before. During his sovereignty he kept the Soudan entirely free from the intermeddling of Cairo, whether that took the form of native or European interference. He found little difficulty in making both ends meet; nor was the Soudan, at the close of his administration, any burden to the Egyptian exchequer, although he paid regular subsidies to the various religious teachers, an expenditure which the control subsequently disallowed. When Gordon left, in 1880, his policy was reversed by his Turkish successors, and to gather in the taxes there was let loose a horde of Bashi-Bazouks, who robbed, plundered, bullied, and ill-treated the unfortunate Soudanese with impunity. Taxes were levied at so heavy a rate that whole districts were reduced to destitution, and thousands of farms went out of cultivation. Of themselves the taxes were oppressive enough, but, under the usual Turkish system, for every pound assessed for the government the officials added another for themselves.

Discontent and rebellion were the natural offspring of such a condition of affairs. In May, 1881, Mahomet Achmet, a native of Dongola, put himself forward as the "Mahdi," a sort of Mohammedan Messiah sent to reform Islam. Practically, however, he personified popular discontent, and his movement was really the outbreak of despair. Thousands flocked around him, and with little delay he commenced operations against the Egyptian forces. In July, 1882, 6000 Egyptian soldiers under Yussuf Pasha were surrounded and massacred, and numerous other forces sent to suppress the Mahdi only avoided the same fate by making common cause with him. Obeid, Bara, and many other places fell into his hands, while the flames of insurrection were spreading over the whole Soudan. Colonel Hicks, a retired Indian officer, was in 1883 appointed to the command of an expedition

against the Mahdi, and defeated him on one or two occasions. The successes, however, were not decisive, and in the autumn Hicks Pasha struck out into the desert, to advance against the centre of the Mahdi's strength at Obeid. For weeks nothing was known of his movements, but at length the news reached Khartoum that the whole of the Egyptian army of 11,000 men, with the general and the other European officers, had been surrounded and destroyed by the rebels about the 3rd November, 1883. The consternation at Cairo was profound, and was increased by the news received a few days earlier that about 600 troops on their way from Suakim to Tokar had been fallen upon and cut to pieces by the rebels in that portion of the Soudan, the British consul Captain Moncrieff, among others, having fallen. The British government, which had at once countermanded the withdrawal of the troops from Cairo, advised the khedive not to attempt the reconquest of the Soudan, but having relieved the invested posts and finally fixed a hold upon the Red Sea coast and the Nile valley as far as Wady Halfa, to maintain the defensive. To relieve some of the invested garrisons Baker Pasha was hurried up to Suakim, and there for a long time he remained while a miscellaneous native force was slowly gathered and drilled by his officers. Baker, it should be observed, was chief of the gendarmerie, or Egyptian police, a force at the utmost only semi-military in its nature, and raised avowedly to maintain order within the limits of Egypt itself. The Egyptian army, now under Sir Evelyn Wood and a staff of English officers, had been recruited on the express condition of not being obliged to serve in the Soudan. Consequently the khedive had positively no force at all which he could with fairness send to Suakim, and the only course open was to compel the service of various contingents, who in many cases were driven at the point of the bayonet, to start upon an expedition utterly repugnant to them. It was a miserable crew which Baker reviewed at Suakim on Christmas Day of 1883, but with indomitable pluck he set to work to prepare them as far as possible for the work in view. There was but little time for such preparation, for the gloomiest tidings were arriving from Sincat and Tokar, at both of which places the garrisons were reduced to extremes. On the 5th February, therefore, Baker Pasha moved forward from Trinkitat, to which place his force had been transported by sea from Suakim in order to shorten the land journey, with a force of about 3600 men, four Krupp guns, and two Gatlings. The order of march was formed with three battalions of infantry in echelon, marching in column of companies, the artillery and cavalry in the front and flanks, and cavalry vedettes extending all round. In the rear were 300 camels. The expedition had reached the wells of Teb, 7 miles from Trinkitat, and the scene of the massacre of the Egyptian troops under Mohammed Tahir in December, where Consul Moncrieff met his death. Here Baker's force was suddenly attacked by a greatly inferior number of Arabs, who threw the cavalry into confusion by their sudden rush from among the sandhills, and then charged down with characteristic impetuosity on the infantry column. The Egyptians were ordered to form square, but their state of panic rendered them unable to carry out this order. A gap was left in the square, through which the Arabs poured, and the scene at once became one of the wildest confusion. The fire of the panic-stricken troops was more fatal to their own officers than to the enemy. Baker, who had been in front with the cavalry, cut his way back through the Arabs only to find that the defeat had become a rout. He estimated the attacking Arabs at only about 1000 men, while his own losses were upwards of 2500, including several English officers.

The situation at this time was one which inspired anxiety throughout Europe, for unless energetic measures were taken at once the fanatical hordes that had overcome the armies of Hicks and Baker, increased in numbers and excited by victory, might advance to the confines of Egypt, and there seemed nothing to prevent the lighting up of a religious war, with its attendant massacres and horrors, from Khartoum to Alexandria. At Sincat the garrison were reduced to sustain life on horse-skins: and when all means of sustenance were gone, and one foraging party after another had been cut off, the commandant, Tewfik Pasha, resolved to escape or perish in the attempt. He and his whole brave force made one desperate effort to fight their way through, but were slaughtered to a man, while the women and children were either massacred or enslaved. At Tokar food and ammunition were said to be almost exhausted, and unless the khedive sent speedy assistance only the fate of Sincat seemed to remain. But the best the khedive could do had been done by Baker's expedition, and Egypt, paralyzed in its physical strength, on the brink of ruin from debt, from rebellion, from war, from cholera, could not make any further effort. British power was at this moment paramount in Egypt, and prompted by a strong popular impulse to save the Tokar garrison if possible, the British government now ordered Sir Gerald Graham, one of the leading generals in the suppression of Arabi's revolt, to hasten to Suakim on this mission of relief. In about three weeks' time he had assembled a force of some 4000 men, comprising detachments of the 10th and 19th Hussars, Gordon Highlanders, Black Watch, 60th Rifles, and Marines. On the 29th February they started from Trinkitat, although news had been received that Tokar had already surrendered. General Graham adopted the square formation as best calculated to meet the well-known Arab tactics of rushing in impetuous masses to the attack. On this occasion, however, it was found that they had entrenched themselves behind rude earthworks, armed with the Krupp guns captured from Baker, which were served by gunners from the Tokar garrison. General Graham resolved to take these works in reverse, an operation which involved marching across the face of the works under the enemy's fire, which was generally ill directed, but caused some losses. When the British force got behind the position, however, the enemy's gunners promptly turned some of their guns round so as to open fire towards their rear. The British replied with small naval guns, and when the enemy's artillery fire was somewhat subdued attacked in the square formation. Their attack was bravely met by the Arabs, who kept under cover until the square was close upon them and then charged madly down upon it, only to be swept away by the concentrated fire of the breechloaders. The works were captured with a much smaller loss than if they had been attacked in front, and two of the enemy's guns were promptly turned against them. After four hours' hard fighting the position remained in the hands of the British. About 2500 of the Arabs were killed, the British losses being some 40 killed and 100 wounded. It was estimated that Osman Digna had about 12,000 men, but by night-time all who had survived disappeared among the mountains, and Sir Gerald Graham's victory was complete. Next day the troops advanced to Tokar, which was found to have been abandoned by the Arabs. The inhabitants came out to greet them, and reported that though their lives had been spared they had been ill treated by the Arabs, and were overjoyed at their relief. Considerable stores of grain were found in the town, proving that it had not surrendered from the effects of famine, and in the neighbourhood a considerable quantity of rifles were discovered and destroyed. General Graham, having resolved to abandon the town, escorted the inhabitants to Trinkitat, whence they were removed along with the troops by sea to Suakim.

It was hoped that this defeat of the Arabs was final, and that the inutility of resistance having been proved

all further opposition would collapse. This view, however, was not shared by Osman Digna. who proclaimed a holy war. So threatening indeed did his attitude become that another advance took place from Suakim on the 12th March, and the British force halted for the night at a "sereeba," or inclosed camp previously formed by Baker, and situated but a few miles from Osman Digna's position. Early next morning, the 13th March, General Graham's force formed up into two squares under Generals Davis and Redvers Buller respectively, and advanced in echelon. When the leading British square reached the edge of a natural depression in the ground a sudden rush was made on them by large bodies of the Arabs, which was met by an attempt of the British to charge. Unfortunately the square formation, being ill adapted for this movement, became deranged, and one side was more or less opened, giving ingress to a horde of Arabs, who advanced totally regardless of losses, and threw the brigade into temporary confusion. It fell back about 500 yards, leaving the machine guns in the hands of the enemy, but speedily re-formed under cover of the fire of Buller's brigade and of a threatened cavalry charge, which checked the rush of the Arabs. Both squares now slowly advanced, the guns were recaptured by the naval brigade, and opened fire on the enemy, who slowly and reluctantly retired before them, incurring enormous losses. After a short halt for rest the first brigade again advanced, captured the village of Tamasi, where Digna's camp was situated, and destroyed a considerable quantity of war material found there. The whole force then returned to the "sereeba" where they had spent the previous night, and next day returned to Suakim.

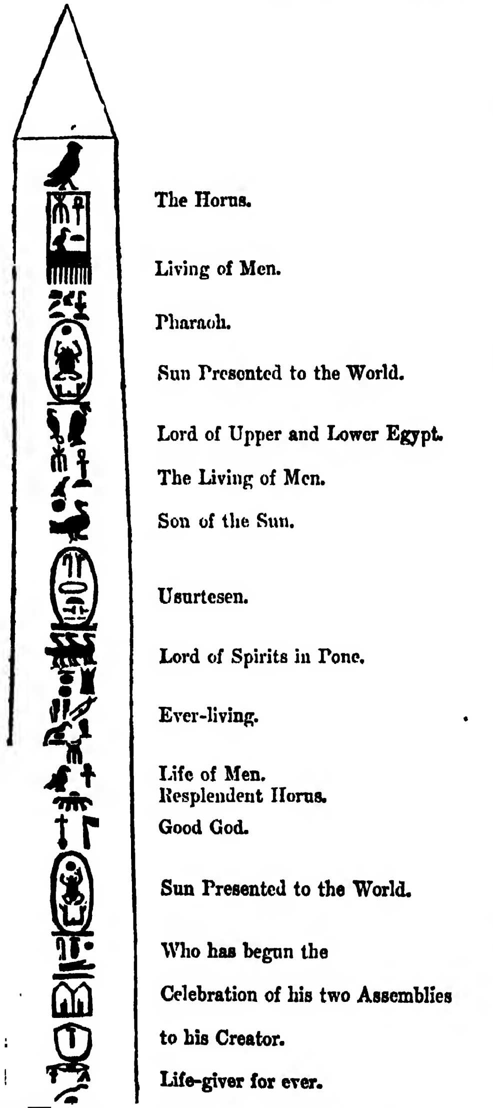
Previous to these events the attention of the government had been turned to the problem of extricating, if possible, the various Egyptian garrisons in the interior of the Soudan. On the 17th of January, 1884, General Gordon was receiving instructions at Brussels from the King of the Belgians with a view to proceeding to the Congo, when he was summoned by telegram to London. He arrived in London on the 18th, and met the leading members of the British government, by whom he was asked to do what he could to relieve the endangered garrisons. He at once consented, and at eight o'clock in the evening he started on his way for Suakim. At Suez, however, he received instructions to proceed instead to Cairo, where he had interviews with Sir Evelyn Baring, Nubar Pasha, and the khedive. By the latter he was invested with full powers as governor-general of the Soudan, and at once set out for Khartoum by way of the Nile and across the desert from Korosko to Berber on camels, thence to Khartoum by steamer on the Nile. He was accompanied by Colonel Stewart, and during the latter part of his journey frequently stopped to hold conference with the Arabs on the banks of the Nile. When he reached Khartoum it appeared as if his mission was to be entirely successful. His presence had the effect of a charm, subduing all disaffection and inspiring the whole population with renewed hope. He made overtures to the Mahdi, on the terms of the latter becoming Sultan of Kordofan. His proposal, however, was refused, and shortly afterwards Khartoum itself was invested. The first sortie ordered by General Gordon was defeated, owing to the treachery of two native officers, who were afterwards executed. This so encouraged the enemy that one after another of the smaller garrisons on the Nile were obliged to yield, Berber itself among them; telegraphic communication with Khartoum was thus entirely cut off, and in an attempt made by Colonel Stewart to communicate with Dongola by steamer his vessel was wrecked, and he and all the Europeans on board massacred. The proposals of General Gordon that Zebehr Pasha, an ex-slave dealer, and formerly a man of great power in the Soudan, should be sent to Khartoum, having been negatived by the British government, and the investment of the city becoming more and more strict, it became at last evident that military aid must be sent. Much discussion took place as to whether the Nile route or that from Suakim should be adopted, but the former was finally fixed on, and a number of whale-boats ordered in England in August for the use of the expedition, which was placed under command of Lord Wolseley in person. The advance was commenced in September, but so great were the difficulties of the navigation found, that it was nearly the end of December, 1884, before the expedition had concentrated at Korti, a point on the Nile south of Dongola, where the route across the Bayuda desert to Metammeh branches off. By this route a mounted force under Brigadier-general Sir Herbert Stewart was pushed forward on the 29th December, in accordance with directions received by messenger from General Gordon, who stated that some of his steamers would meet them at Metammeh. The march was successfully executed, although two severe actions were fought at Abu Klea and El Gubat, the general in command being mortally wounded just before the second. A fortified camp was established on the Nile a short distance above Metammeh, and four steamers having been met there, two of them, under command of Colonel Sir Charles Wilson, started for Khartoum on the 24th January, 1885. They arrived there on the 28th, only to find the place in the hands of the enemy, and to learn that it had fallen through treachery of part of the garrison on the 26th, General Gordon and all the Europeans, with part of the troops, having perished. The news of this disaster and of Gordon's fate excited the keenest grief in England and throughout the world. It also necessitated a complete change of campaign. By Lord Wolseley's direction a force was despatched to Suakim under General Sir Gerald Graham to open up the desert route to Berber, and if possible lay a railway along it, while the advanced columns both on the Nile and at Metammeh were withdrawn to Korti. The Australian colonies offered to despatch forces to Suakim in aid of the expedition from that point. Their offers were accepted, and one detachment, that from New South Wales, left at once amid general enthusiasm, and arrived at Suakim in time to take part in some of the latest operations there. After some miles of railway had been laid, and the Arabs under Osman Digna repulsed in several actions with great loss, the British government, in view of serious disputes with Russia on the Afghan frontier question, decided to withdraw both expeditions from the Soudan, and abandon the province of Dongola, which operations were gradually carried out under the supervision, but contrary to the advice, of Lord Wolseley, who paid a visit to Suakim to ascertain the exact position of matters there. In July, 1885, news was received that Mahomet Achmet, the Mahdi, had died of smallpox the previous month.

Meantime the financial difficulties of Egypt, which had grown more and more serious since the indemnities for destruction of property at Alexandria had been awarded but could not be paid, were relieved by the issue of a new loan of £9,000,000 under the joint and several guarantee of the great powers of Europe, and the British government despatched Sir H. Drummond Wolff to Egypt as special commissioner, to investigate on the spot the condition of affairs in conjunction with Ahmed Moukhtar Pasha, a commissioner appointed by the Sultan. The investigation was prolonged into 1887, great difficulty being experienced in reconciling the demands of Turkey, to have the date of a complete British evacuation fixed, with the actual requirements of the situation. At the end of 1886, however, the British force in Egypt had been reduced to 8000 men, and still further reductions were contemplated.

("Egypt," by Mr. Stanley Lane Poole, London, 1882; "Egypt," by G. Ebers, translated from the German, London, 1882.)

EGYPTIAN ARCHITECTURE. In the buildings of the ancient Egyptians the profile of the columns is vertical, or nearly so, while that of the walls is sloped, thus producing the same degree of contrast between the two which is observable in the Greek Doric, although the mode adopted in the one case is just the reverse of that pursued in the other.

The cornice in Egyptian architecture consists of little more than a deep cove, enriched with sculpture—a form



Obelisk of Heliopolis (Usurtesen I., twelfth dynasty), now in the square of the Lateran at Rome.

peculiarly adapted for effect in a climate like that of Egypt, as it not only casts a bold shadow, but receives a strong reflected light.

With the cornice the building terminated, for the roof, being a flat terrace, was not an architectural feature; consequently Egyptian architecture is entirely destitute of what are such expressive and highly ornamental features in that of Greece—namely, the pediment, antefixæ, and ridge-tiles. Like every other part of the front in the same edifice, the walls are decorated with brightly coloured sculpture, hieroglyphics, and sunk bas-reliefs; for the Egyptians were very profuse of that species of embellishment, not confining it to particular situations, as the Greeks did, but extending it over the entire surface.

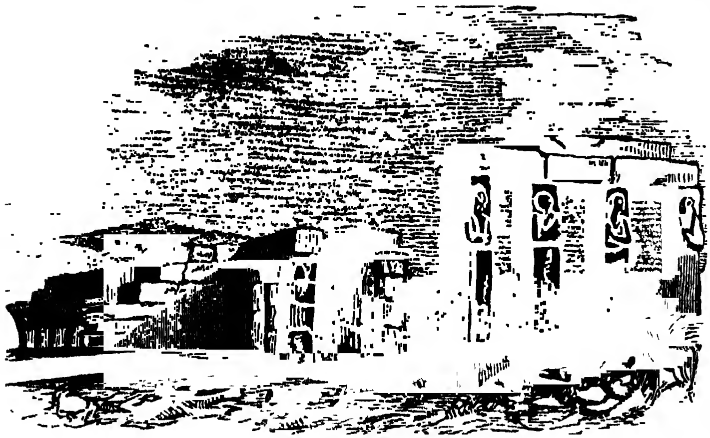
As regards the general plan of Egyptian temples, we may describe that of the great temple at Edfu, or Apollinopolis Magna (fig. 1 of Plate). The temple is placed within an inclosure, forming a court in front of it, surrounded on three of its sides by colonnades; and the entrance to this court was through a colossal doorway, or propylæum, placed between two enormous pyramidal towers or moles, covered with colossal figures in sculpture. These vast masses of structure, which rose considerably higher than the temple itself, had the usual hollow cornice, and may almost be said to be solid, for the chambers and staircases which they contained were little else than empty spaces left in the mass. Within the court the colonnades were very close, the columns being seldom more than a diameter and a half from each other, except in the centre of a portico, where there was generally a doorway between the columns, the lower part of the other intercolumns being walled up.

In Egyptian architecture the propylæa or gateways are conspicuous and important features, whether insulated, after the manner of arches or gateways, or as in the above example placed between and connecting two pyramidal moles that rise to great elevation above the entrance itself. Some idea may be given of the imposing magnitude of such doorways by stating that the side masses of the one at Edfu measure 74 feet, and 51 to the summit of the aperture, which gives a depth of 23 feet, or nearly one-third of the whole height, for the lintel and cornice.

The magnificence of these propylæa was greatly enhanced by colossal statues or obelisks, in some instances both, placed on either side of the entrance. Besides which there were sometimes two or even more propylæa and courts preceding the temple, which were in their turn preceded, as at Karnak, by avenues of gigantic sphinxes or krio-sphinxes (that is, sphinxes with rams' heads). There are likewise instances of avenues of columns crossing the courts in a line from the entrance, as at Luxor. As to the pyramids, though interesting in themselves, they are structures so very peculiar as to have little connection with the architecture of the country, being, when considered with reference to it, little more than uniform and simple though enormous masses. Their shape is so familiar to every one that it requires no description, but may be defined as square in plan and triangular in section, the four sides being so many triangles united so as to terminate in a point; and as the perpendicular height is much less than the width of the base, each side constitutes nearly an equilateral triangle. Their importance renders it necessary to make them the subject of a separate article. See PYRAMIDS.

The principal monuments of Egyptian architecture are distributed along the banks of the Nile not far from the river. The nearest to the sea of those of chief importance are the ruins of the granite temple of Isis, near Mansourah, on the Damietta branch of the Nile in the Delta. The fragments lie upon the site, 200 feet by 600 feet. The materials must have been brought more than 600 miles, and altogether Egyptologists consider it to have been the costliest temple in Egypt. It was probably built during the last dynasty. Heliopolis, with its remaining obelisk of Usurtesen I. (about 2360 B.C.), the companion to which is now on the Thames Embankment at London, while another has been for centuries in the square of St. John Lateran at Rome, lies to the north of Cairo, between that town and the apex of the Delta. Close to Cairo, a little to the south and on the west bank, lies Gizeh, with the great pyramids and their six smaller satellites, and the

majestic Sphinx. Here was the great necropolis of the ancient Memphis, placed at the nearest edge of the desert to that town, Memphis lying 10 miles south of modern Cairo. Round the royal pyramid-sepulchres are the tombs of the nobles. Many pyramids are known to have been destroyed. A little to the south of the pyramids of Gizeh are those of Abou Seir (fourth dynasty, about 3100 B.C.), also three in number, but much smaller, near which the fine step-pyramid of Sakkarah, the oldest building in the world, if, as said in the article EGYPT, we may place its date about 3810 B.C. Yet further south, but still visible from the citadel of Cairo, are the two stone and three brick pyramids at Dashoor, the first of which alone approach in size the great pyramids at Gizeh. Still more of these structures are found fringing the cultivable land, down to the early pyramid of Senofern (third dynasty, about B.C. 3200) at Fayoom; but the necropolis of Memphis must be held to stop at Dashoor. Between Abou Seir and Sakkarah lie the remains of the Serapeum, and some private tombs containing true stone arches, but without a keystone (brick arches are also found near Thebes), showing



Ruined Temple at Thebes.

that the Egyptians understood the construction, though they declined to make use of it. Of the great temple of Ptah at Memphis very little remains except the magnificent colossus of Ramses II., a standing figure once 40 feet high, but now prostrate and broken at the knee. Near Fayoom the remains of Lake Moeris and the labyrinth of Amenemhat III., of the twelfth dynasty [see EGYPT], still exist, discovered by Lepsius in 1843; and close by are the ruins of the ancient Crocodilopolis. Near Minyeh begin the rock tombs of the later dynasties, which they constructed instead of pyramids; not far above the town are those of Beni Hassan, the most splendid of all, saved by the energy of the English consul in 1850 from being used (as some of their neighbours had already been) as building-stone quarries. They are of the twelfth dynasty (beginning B.C. 2380), and are excavated in the face of the eastern mountains near the river, at no great height. Some have porticoes; all are crowded with splendid sculptures and paintings, depicting every phase of the life of the time. A little above is the site of the town of Antinoe, founded by Hadrian [see ANTINOUS], and not far south of this are the tombs from which we derive our knowledge of that curious deviation to sun-worship occurring at the close of the eighteenth dynasty, a little after 1550 B.C. [See EGYPT.] Some distance higher up the Nile lies Girga; and near this is the supposed site of Thinis, the birthplace of the first dynasty. The sacred city of Abydos afterwards stood on the ruins of Thinis, and Abydos yet contains the two famous temples of Osiris (one of whose burial-places Abydos was), built by Ramses II. and his father, Seti I. Hence came the list of Pharaohs which is one of the most valued treasures of the British Museum. Forty miles south of Abydos we find Denderah (Tentyris), and near it the site of the smaller Diospolis. The temple of Denderah is about a mile and a half from the river, and is a fine structure, though the art was in its last decadence. Domitian and Trajan are represented, in the conventional manner, sacrificing. Elsewhere Cleopatra and Cæsarion, her son (as she said) by Julius Cæsar, are represented. One of the columns of Denderah and a fine doorway are shown in figs. 3 and 4 of Plate.

The ruins at Thebes lie at some distance from the Nile on both sides, covering a space about 2 miles north to south, and 4 miles east to west. The finest are the collection of temples at Karnak, where is the unequalled hall, crowded in a surprising manner with splendid columns, whose style of architecture is shown in fig. 2 of Plate. Close to Karnak is Luxor, with the avenue of ruined sphinxes. Connecting them, and in front of the latter temple, stands the fine obelisk the fellow to which has ornamented since 1831 the Place de la Concorde at Paris. Ramses II. (1430–1363 B.C.) is the often-celebrated hero of Luxor. On the west bank is a fine small temple of Seti I., father of Ramses II.; and the magnificent structure of the latter monarch, most princely of all the Pharaohs, often called the Memnonium. Here is that colossal statue of Ramses lying in pieces, once a single block of red syenite, which weighed, Sir Gardner Wilkinson has computed, over 800 tons, and stood 60 feet high, the king being seated. Half a mile to the south-east of the Memnonium (Rameseum) are the sole survivors of a superb assemblage of obelisks and colossi, by themselves alone wonders of the world. These are the twin colossi, one of which is called the "vocal Memnon," from a superstition that the first rays of the rising sun caused it to vibrate in a musical note. (Greek and Latin inscriptions on the statues record how Hadrian and his court heard this wonderful sound.) They are 47 feet high and 60 feet apart; and both of them represent King Amenophis III. (about 1500 B.C.), that king of the eighteenth dynasty whose foreign (perhaps Indian) queen brought in her train the sun-worship, soon for a time to rule predominant. Half a mile further to the south-west is the great group of temples at Medeenet Abou, built by Ramses III., second king of the twentieth dynasty (about 1260 B.C.), not inferior as a conqueror to Ramses II. (1430–1363 B.C.), and whose wars form the subject of the numerous and vivid bas-reliefs. Countless tombs surround the great temple-group, one of them (that of Pet Amenapt) occupying an area not less than 23,809 square feet, and with its passages, &c., standing on an acre and a quarter. Here, too, is a fine temple where Thothmes III. has cut his name over that of its builder, his sister, the regent Hatshepu, as noticed in the article EGYPT. Behind the temple of Seti (Setheum) is the long winding valley which leads to the "tombs of the kings." These are splendid tombs of the monarchs of the eighteenth, the nineteenth, and the twentieth dynasties—that of Ramses III. being the most splendid, though not the most delicate, of all. At Edfu (the Apollinopolis of the Greeks) is the well-known Ptolemaic temple of our Plate, figs. 1 and 5, at first

sight one of the most stately of Egyptian buildings, but not bearing inspection like the earlier art. Some of the lotus-flower capitals at Edfu are superb. Eleven miles above Jebel es Silsileh is the extremely picturesque temple of Ombos, situated in a great inclosure of brick walls, Ptolemaic for the most part, but with portals and other parts by Queen Hatshepu, her name erased as usual by Thothmes III. Another 20 miles and the island of Elephantine is reached, with the famous Roman nilometer, two temples, and many dimly indicated ruins. Passing the first cataract, not a difficult feat with a northerly wind if the river is in flood, and leaving Egypt proper, after about 2 miles the exquisitely beautiful and well-preserved island of Philæ comes into sight. It is only 34 miles north of the Tropic of Cancer. Its whole area of 500 yards by 100 yards is covered with temples. Roman, Greek, Ptolemaic, and late Egyptian vie with each other in interest. It was one of the most sacred spots in the world. Isis herself was held to have built upon it a tomb or temple to Osiris, one of whose burial-places it was. It forms a majestic monument close to the lovely panorama of the Nilote antiquities.

It needs notice that by a striking peculiarity in Egyptian art the main types of every form and style of colouring, which were early fixed, were never departed from. The architectural remains of Egypt are especially interesting as being by far the most ancient yet known in the world, and giving us a glimpse into the life and manners of a people that had attained a wonderful civilization long before the dawn of what we know as history. On their architecture we quote the opinion of Fergusson—"We may perhaps safely assert that the Egyptians were the most essentially a building people of all those we are acquainted with, and the most generally successful in all they attempted in this way. The Greeks, it is true, surpassed them in refinement and beauty of detail, and in the class of sculpture with which they ornamented their buildings, while the Gothic architects far excelled them in constructive clearness, but with these exceptions no other styles can be put in competition with them."

EGYPTIAN VULTURE (*Neophron percnopterus*), the Pharaoh's chicken of European travellers, occurs commonly in the south of Europe, but it extends its visits further to the north, having been killed even in Norway. It is especially abundant in Greece, Arabia, and Egypt, but is also met with in great numbers in India, and is stationary all the year round in Spain, Italy, and the south of France. Individuals have also been killed in England. In the winter it visits the Cape of Good Hope.

The characteristics of the genus Neophron consist in the great development of cere, which occupies two-thirds of the length of the beak; in the elongated longitudinal nostrils; and in the nakedness of the face and throat, while the back of the head and neck are clothed with feathers. The present species is small, measuring only about 2½ feet in length; its plumage is white, with the extremities of the wings black; the naked skin of the face and throat is yellow, the beak lead colour, the feet yellow, and the claws black.

The Egyptian vulture builds its nest among the rocks, and lays from two to four eggs of a white colour, but usually more or less spotted with brownish-red. It seeks its food, however, principally in the towns and villages, where it feeds promiscuously with the dogs and jackals on the carcases of animals and other putrefying filth, which appears to be so peculiarly abundant about the habitations of Eastern nations. It is said to be the foulest feeder known even among the carrion-loving vultures. Its efficiency as a scavenger is recognized in Egypt, and protection is afforded it. This vulture follows the caravans in the desert, and preys on the bodies of dead camels, &c.

EHRENBREIT'STEIN (meaning "honour's broad stone"), a town on the right bank of the Rhine, in the circle of Coblenz, in the Prussian Rhine Province. It is situated at the foot of a precipitous height rising 772 feet high, and opposite Coblenz, with which it is connected by a bridge of boats and also by an iron railway bridge. The civil population is 5000. Above the town stands the fortress of Ehrenbreitstein, which, with three forts on adjacent heights, commands the mouth of the Moselle and the approaches from the lower Rhine. The road up to it from the town, which is about 1200 paces long, is strongly fortified. To the "Cavalier," or highest point of this formidable stronghold, strangers are not admitted; but the prospects from other points are extensive and beautiful. This fortress was taken in 1799 by the French, who demolished all the works, but they have been since rebuilt with considerable additions. See COBLENZ.

EIDER-DUCK (*Somateria mollissima*) is a large DUCK, belonging to the sub-family FULIGULINÆ, well known as furnishing the soft light down known as *eider-down*. The eider-duck dwells on the coasts of the cold seas of the north; the peculiar softness and elasticity of the down preserve the necessary amount of heat in the bird's body. These ducks are never seen in fresh water. They are only partially migratory, the older birds seldom moving further southwards in winter than to permanent open water. They extend as far north as Davis' Strait and Baffin's Bay. In Lapland, Norway, Iceland, Greenland, and at Spitzbergen the eider-duck is very abundant; and it abounds also at Behring's Island, the Kuriles, the Hebrides, and Orkneys. In Sweden and Denmark it is said to be more rare, and in Germany to be only observed as a passenger. The most southern breeding place is the Fern or Farn Islands, on the coast of Northumberland.

The male of this species has the cheeks white, the top of the head black, the back of the head green, the back and smaller wing-feathers white, the primaries and secondaries and the great wing-coverts black, the lower surface and tail black, and the neck white, with its lower part pale buff; the bill is dusky green, with its tip white, and the feet are green. The length is rather more than 2 feet. The female is pale brown, variegated with spots of a darker brown. The male does not acquire his full plumage till the third year, till which time he resembles the female in plumage.

The eider-ducks build their nests on the rocks of dry grass or seaweed. They feed on crustaceans and molluscs. When the first eggs are deposited, usually about five in number, the duck strips the down from her breast to line the nest. The eggs and down are taken by the owner of the nest. The duck lays more eggs and supplies more down, which are again abstracted. In this way the supply is kept up throughout the season, the bird being allowed to hatch the last two or three eggs. There seems no foundation for the story that the drake plucks his breast when the duck's down is exhausted. The down thus plucked from the living bird's breast is called *live* down, and is very superior in lightness and elasticity to that taken from the dead bird, which is distinguished as *dead* down. The eider-duck is of great value both on account of its eggs and of its down. In Iceland and Norway they are considered valuable property, and are protected in every way possible. In some cases artificial islets for nesting places have been made.

EI'KON BASIL'IKE (Gr., the royal image), a book issued in 1649, professedly written by Charles I. during his confinement in explanation of his aims and policy. It was in reality the work of Dr. Gauden, bishop first of Exeter and afterwards of Worcester, though it is not improbable that the manuscript was submitted to Charles for his inspection and approval before publication.

EIRENE. See IRENE.

EI'SENACH, the chief town of the circle of Eisenach, in the duchy of Saxe Weimar, is situated at the confluence

of the Hörsel and Nessel, which unite immediately north of the town, and has 18,624 inhabitants. The celebrated Wartburg, a mountain fastness, commands it on the south. The town is surrounded by walls, has five gates, is well built, and has broad, clean, well-paved streets. The grand-ducal palace is a large and handsome edifice. Among the public buildings and institutions are—five churches, a gymnasium with an extensive library, a training school, an academy for young men designed for the profession of superintendents of woods and forests, a school of design, a free-school, a house of correction and orphan asylum, hospital, an infirmary, and several philanthropic associations. The chief manufactures are woollens, cottons, linens, soap, white lead, meerschaum pipes, leather, and carpets. The little chapel in the Wartburg, in which Luther frequently preached in 1521, on his return from the Diet at Worms, with its altar-piece, a fine carving in wood representing the entombment of Christ, and the cell which Luther inhabited, have been carefully preserved in the same state as when he used them. In the ancient portion of the Wartburg are the baronial hall in which the Minnesänger held their poetic contests; and the armoury, in which are several curious relics and beautiful suits of armour. Eisenach was the birthplace of Bach the composer in 1685.

EIS'LEBEN, a town of Prussia in the province of Saxony, famous as the birthplace of Luther in 1483, and likewise the place of his death in 1546, is situated 16 miles N.W. from Halle, on a hill above the Böse, and contains several churches, a gymnasium, schools, hospitals, and 18,187 inhabitants, who are engaged in a brisk inland trade, in the manufacture of potashes and tobacco, in linen weaving, and in the silver and copper mines and smelting works of the neighbourhood.

EIS'TEDDFOD (from the Welsh *eistedd*, to sit), a meeting or assembly. This term is more especially used as the name for a festival which has been held in Wales for several centuries. The object of the gathering, which lasts for several days, is the preservation and encouragement of the language, literature, and arts of the Cymry. This is sought to be effected by the award of prizes for composition in music, poetry, and literature, which awards are made after public competition. The most ancient national forms and ceremonies are preserved, and an antiquity of 1200 years is claimed for the festival itself. The first proceeding is the opening of the Gorsedd, or Council of Bards, to which the members, bards, ovates, Druids, minstrels, &c., go in procession. This takes place by proclamation, in Welsh and English, at the Cylch, which is a Druidical circle of twelve stones, placed upright at regular intervals round one flat stone, supported on four smaller ones, the whole signifying mystically the zodiac and its twelve divisions. At this ceremony degrees are conferred upon the approved candidates for bardic and other honours. When the Gorsedd is closed, the procession moves to the pavilion where the Eisteddfod is held, under a president. Here the competition for prizes takes place, various poems being recited and sung, essays read, and musical compositions performed.

EJECT'MENT is the name of an action at law by which a party entitled to the immediate possession of land or other corporeal hereditaments may recover that possession from the party wrongfully withholding it. Since the enactment of the 3 & 4 Will. IV. c. 27, for the limitation of actions and suits, &c., it has become the only mode of trying the title to lands and tenements.

The remedy by ejectment was founded almost entirely upon a succession of legal fictions. See Doe, John.

Where ejectment is brought for non-payment of rent, a demand for rent by the landlord in person must be made, and precisely on the last day it must be made, to save forfeiture, and, according to Lord Tenterden, at sunset; but if there be not sufficient distress on the premises the landlord can proceed under the Common Law Procedure Act, 1852, s. 210, where half a year's rent is in arrear without demand. By the same Act, s. 217, some special provisions as to ejectment in reference to lands out of London and Middlesex are enacted, but the use of them is optional to landlords. By 23 & 24 Vict. c. 126, s. 1, "in the case of any ejectment for a forfeiture brought for non-payment of rent, the court or a judge shall have power, upon rule or summons, to give relief in a summary manner, but subject to appeal as hereinafter mentioned, up to and within the like time after execution executed, and subject to the same terms and conditions in all respects as to payment of rent, costs, and otherwise as already mentioned; and if the lessee, his executors, administrators, or assigns shall upon such proceeding be relieved, he and they shall hold the demised land according to the lease thereof made, without any new lease." According to the previous law relief might have been obtained in equity within six months after execution executed, upon payment of the rent and all arrears with full costs. And sometimes even at a later period, until from the great lapse of time, or other special circumstances, it came to be considered unreasonable to grant such relief.

By 19 & 20 Vict. c. 108, s. 52, "when the rent of any corporeal hereditament, where neither the value of the premises nor the rent payable in respect thereof exceeds £50 by the year, shall for one half year be in arrear, and the landlord shall have right by law to re-enter for the non-payment thereof, he may, without any formal demand or re-entry, enter a plaint in the county court of the district in which the premises lie for the recovery of the premises."

A mortgagee may maintain an action of ejectment against the mortgagor to gain possession of the mortgaged premises without giving any notice, unless the mortgagor is protected by the covenant for quiet enjoyment until default; but on payment of mortgage interest and costs, the mortgagee must reconvey to the mortgagor. He may also eject the lessee to whom the mortgagor has made a lease subsequent to the mortgage without giving him notice to quit. Where the right of the tenant to retain the possession has ceased by the effluxion of time, by a legal notice to quit, or by the commission of an act of forfeiture, a landlord may bring an ejectment against his tenant.

In Scotland this form of action is limited to the removal of tenants or vitious possessors, and is not, as in England, the form of action to try the validity of titles, which is done by action of *declarator* in the Court of Session.

By the Act 16 & 17 Vict. c. 80, a summons of removing may be raised at any time provided there be an interval of at least forty days between execution of the summons and the term of removal. As to houses within burghs certain facilities are given by 44 & 45 Vict. c. 39. Applications for summary removal without warning are competent against such as have no legal title.

EKAT'ERINBURG or **YEKATERINBURG,** the most important town, though not the capital, of the government of Perm, in the western part of Asiatic Russia, stands on the Isset, and has 26,000 inhabitants. The town, part of which is built on an eastern slope of the Ural Mountains, is fortified and regularly constructed. It is the centre of a large mining district—gold washing, iron and copper smelting, amalgam works, the cutting and polishing of porphyries, agates, and jaspers, being actively carried on. There are two cathedrals, numerous churches, a school and council of mines, botanic garden, museum, mint, arsenal, and chemical laboratory. As Ekaterinburg lies on the high-road leading from European Russia to Siberia it is a place of brisk trade.

EKAT'ERINOSLAV, the capital of the province of Ekaterinoslav, in Southern Russia, founded in 1787, stands on the right bank and just above the falls of the Dnieper,

and has 25,000 inhabitants. The town is close to the foot of a mountain, and is built according to a regular plan. The streets are broad and straight. There are several churches, a gymnasium, and an ecclesiastical seminary, an imperial manufacture of woollens, and several hospitals. The town is the seat of an archbishop. Silk stockings and woollen cloth are made, and some retail trade is carried on.

EK'LOGITE or **EC'LOGITE** is an igneous rock consisting of garnet (red or red-brown), smaragdite, omphacite (a bright-green variety of augite), and occasionally disthene (whence it is sometimes called *disthene rock*), pyrites, olivine, zircon, apatite, and sphene. As might be expected from the nature of its constituents, the rock is a very beautiful one and is unrivalled for brightness of colour, except perhaps by luxullianite and the epidote granite of India.

ELÆAGNA'CEÆ, a small order of MONOCHLAMYDEÆ. The fruit is soft, succulent, and would be eatable if it were not for its dryness and insipidity. In a few cases, when it is more than usually juicy and acidulated, it is actually considered an excellent fruit. Species of the genus Elæagnus are called the wild olive or oleaster, but the true olive (Olea) belongs to a different order, the Oleaceæ. *Elæagnus hortensis* and *orientalis* bear a brown fruit, about the size of an olive, which is brought to market in Persia under the name of "zinzeyd;" in quality it is like a jujube. The red drupes of *Elæagnus conferta* and the large olive-shaped ones of *Elæagnus arborea* are in like manner eaten in India. The only species found wild in Great Britain is the *Hippophäe rhamnoides* (the sea buckthorn), a spiny shrub found growing on cliffs near the sea; its fruit, when the acidity is sufficiently covered by sugar, becomes a rather pleasant preserve. It is sometimes eaten in fish-sauces, but its use requires caution, as it is narcotic. *Elæagnus angustifolia*, a native of the eastern parts of Europe, is one of the most fragrant of all plants. Its dull yellow flowers, hardly remarked among the leaves, fill the atmosphere with a delicious perfume, the source of which is not readily discovered by the passer-by. Elæagnaceæ differs from other orders included with it in the series Daphnales in the following particulars:—The flowers are diœcious or polygamous; the perianth, constructed above the ovary, is persistent at the base, deciduous above, with two or four lobes; the stamens are as many as the lobes, and alternate with them, or twice as many; the ovary is one-celled, with a single erect ovule; the radicle is inferior. The leaves are covered with scale-like hairs, which form beautiful microscopic objects, and give the leaves a silvery appearance.

ELÆ'IS, a genus of PALMS, so named from *elaia*, the olive-tree, because an oil is yielded by the fruit. *Elæis guineensis* (the oil-palm) is common all along the western coast of Africa. The oil is obtained by bruising the fleshy part of the fruit, and subjecting the bruised paste to boiling water in wooden mortars. An oil of an orange-yellow colour separates, which concretes when cool to the consistence of butter, and has when fresh the smell of violets or of the root of the Florentine iris, with a very slightly sweetish taste. This oil is used by the Africans in cookery and for anointing the body. It forms a considerable article of commerce with Europe, where it is employed chiefly in making candles, soap, and also for greasing the wheels of railway carriages. The oil obtained from the South African species, *Elæis melanococca*, has not been imported in any large quantity.

In this genus the leaves are very long, feather-shaped, with prickly stalks; the flowers are either male or female, in distinct clusters; the fruit is fleshy, with a hard stone, of a yellow or vermilion colour, somewhat angular and pear-shaped, about an inch and a half long.

ELÆOCAR'PUS, a genus of chiefly Indian trees, having a strong botanical resemblance to our European lindens. Some botanists regard them as a suborder of TILIACEÆ, the chief distinctions being deeply cut or fringed petals and anthers opening at the apex. Some few have been found in the South Sea Islands, New Zealand, and Australia.

In India the nuts, cleared of the soft pulp or flesh that covers them, are curiously sculptured, and being bony and taking a fine polish, they are frequently set in gold and strung into necklaces. The nuts of *Elæocarpus ganitrus*, a middle-sized tree common in various parts of India as well as the Malay Archipelago, and those of *Elæocarpus tuberculatus*, from the forests of Travancore, are what are principally used for this purpose. The fruits of *Elæocarpus serratus*, which are very much like olives when ripe, are pickled or dried and used in their curries by the natives of India. *Elæocarpus cyaneus* has pure white beautifully fringed petals, and is one of the most ornamental plants of Australia.

ELÆODEN'DRON, a genus of plants belonging to the order CELASTRINEÆ. The species are small trees with opposite or alternate entire glabrous leaves. *Elæodendron glaucum* is a small tree about 14 feet in height, and is a native of the hotter parts of India, Ceylon, and the Malay Archipelago. The tree has been introduced into Great Britain from Ceylon under the name of Ceylon tea. It has leaves like those of the tea-plant, but it does not appear to be used as a substitute for that plant. It possesses powerful astringent properties, but is not used as an internal medicine. The bark of the roots rubbed with water, while still fresh, is applied to reduce swellings. The fruit of all the species resembles that of the olive, and hence the generic name. *Elæodendron orientale* is a native of the Mauritius and Madagascar, where it is called by the French *bois d'olive*. There are thirty species, found in most tropical countries, but there are very few in South America, and none in tropical Africa. The parts of the flowers are in fours or fives; the ovary is continuous with the disc, and generally three-celled, with two erect ovules in each cell, the fruit is a dry or pulpy drupe.

ELAGAB'ALUS (called also **HELIOGAB'ALUS**), was the grandson of Mæsa, sister to the Empress Julia Domna, the wife of Septimius Severus. Mæsa had two daughters, Sæmis, the mother of Varius Avitus Bassianus, and Mammæa, mother of Alexander Severus. Varius was born at Antioch, A.D. 204. Mæsa placed him, when five years of age, in the Temple of the Sun at Emesa, to be educated by the priests; and through her influence he was made, while yet a boy, high priest of the Sun. That divinity was called in Syria Elagabal, which name the boy assumed. After the death of Macrinus, the successor of Caracalla, Elagabalus, as the young Varius was now called, was proclaimed emperor, A.D. 218, his grandmother Mæsa giving out that he was the son of Caracalla by an illicit connection with her daughter Sæmis. The troops at once saluted him emperor. Elagabalus having entered Antioch, wrote a letter to the senate professing to take for his model Marcus Aurelius Antoninus, and assumed that emperor's name. The senate acknowledged him, and he set off for Rome, where he arrived in the following year. His career of debauchery, extravagance, and cruelty lasted the three years of his reign, and the disgusting details are given by Lampridius, Herodianus, and Dion. He surrounded himself with gladiators, actors, and other base favourites. He married several wives, among others a vestal. The imperial palace became a scene of debauch and open prostitution. Elagabalus being attached to the superstitions of the East raised a temple on the Palatine to the Syrian god whose name he bore, and plundered the temples of the Roman gods to enrich his own. His grandmother Mæsa seeing his folly thought of conciliating the Romans by associating with him as Cæsar (A.D. 221) his younger cousin, Alexander Severus, who soon became a favourite with the people.

Elagabalus, who had consented to the association, soon became jealous of his cousin, and wished to deprive him of his honours. His measures produced an insurrection among the prætorian guards, and having repaired to their camp to quell the mutiny Elagabalus was murdered, together with his mother and favourites, and his body was thrown into the Tiber in March, 222. He was succeeded by Alexander Severus. The coins of Elagabalus bear the names of Marcus Aurelius Antoninus, like those of Caracalla, with which they are often confounded.

E'LAND (*Boselaphus oreas*) is an ANTELOPE, the largest and most valuable of its family. An adult male stands fully 6 feet high at the shoulder or even more, the length being in some cases upwards of 9 feet from the nose to the root of the tail. The horns are nearly straight, massive, conical, and furnished with a strongly-developed spiral ridge, which gradually disappears, the ends becoming attenuated and sharply pointed. In the female the horns are longer, slighter, and less markedly furrowed. The forehead of the male is clothed with a thick bundle of stiff, wiry, brownish hairs, the tuft being bordered on either side by a band of yellow-orange colour. The ears are comparatively small and the muzzle broad, the neck thick, the dewlap very prominent and fringed with long brown hairs, the legs rather short, the shoulders and hind quarters enormously developed, the fur short and of a dark red or ashy-gray colour generally, the tail being about 26 inches long and tufted at the extremity. The female exhibits a bead-like tuft of hair on the under part of the neck, has a more ferruginous colour, and is furnished with four teats. Respecting the habits of this interesting animal, which is a native of South Africa, it is well known to frequent only the more open plains of the interior; "rejoicing especially," says Captain Harris, "in low belts of shaded hillocks, and in the isolated groves of *Acacia capensis*, which, like islands in the ocean, are scattered over many of the stony and gravelly plains of the interior."

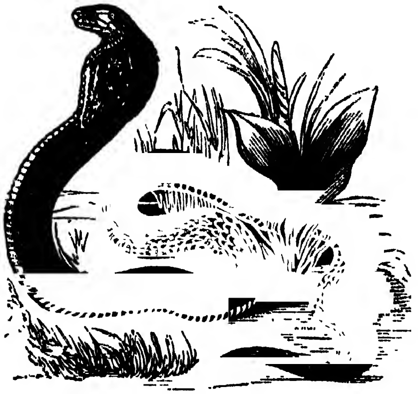
The eland, from its unwieldy bulk, is readily captured. The importance of this antelope will be at once appreciated when it is mentioned that not only is its flesh of the most

The Eland (*Boselaphus oreas*).

palatable and nutritious character, but experiments have recently established the fact that it will readily breed in this country. When it is added, moreover, that several are now thriving in the parks of English noblemen, and that a single individual weighs from 1500 to 2000 lbs., it will be easily understood that the day may not be far distant when the eland will become permanently domesticated in this country, and supply wholesome food, at least to the table of the wealthy. At one time elands were abundant in the immediate neighbourhood of Cape Town, but now very few are found within the borders of the colony. Considering the facilities which exist for their destruction, and the gentle disposition of the animal, every effort should be made to follow up the experiments of domestication so successfully commenced by the Zoological Society.

ELAP'IDÆ, a family of venomous SERPENTS which, with the sea-snakes (Hydrophidæ), forms the suborder Proteroglypha, characterized by the possession of grooved fangs. These serpents, though highly venomous, approach in general form so nearly to the harmless serpents that even an experienced eye has difficulty in distinguishing them at first sight. They differ from the venomous sea-snakes by the absence of the flattened tail; and they cannot be confounded with the viperine serpents, as they have neither the heavy shape, the broad triangular head, the vertical pupil, nor the keeled scales. Their body is more slender than either of these two families. Their tail is rather short, often conical, or of equal thickness throughout, and rounded at the extremity. The head, which is generally of the same size and on a line with the neck, is small and short, with a thick, slightly conical, and most frequently a blunt or rounded muzzle. The eyes are rather small, sometimes vertical, and the pupil is round. The scales with which the body is covered are numerous, and with one exception always smooth. The organs constituting the poison apparatus are much less developed than in the viperine species; they do not appear to have the power of opening their jaws so wide as these latter serpents have, and consequently are not able to elevate the fangs so much, nor cause such deep and dangerous wounds. The venomous teeth or fangs are fixed in front of the maxillary bones, are large and grooved, and are followed by smaller hooked ungrooved teeth. The palate and pterygoid bones, as well as the lower jaw, have hooked teeth. Some of this family, as the formidable cobra, have the power of dilating the skin of the neck so as to form a kind of hood. These

serpents are abundant in the tropics, especially in India. The species are tolerably numerous. The genus Naia contains the Indian Cobra di Capello, the most dreaded of serpents, as well as several South African species. The genus Ophiophagus contains the large Snake-eater (*Ophiophagus elaps*), very widely distributed in Asia. The genus Bungarus contains two very dangerous species,



Cobra (*Naia tripudians*).

natives of India. Australia is well represented among the Elapidæ, the most deadly perhaps being the Death-adder (*Acanthophis antarcticus*). The genus Elaps occurs in South and Central America.

ELASTIC TISSUE, the yellow tissue which forms the basis of areolar connective tissue. It forms almost the whole of the *ligamentum nuchæ* (the powerful neck ligament which holds up the drooping head of quadrupeds), of the vocal chords and windpipe, and of the coats of the arteries and veins, besides supplying the bulk of the tissue of the lungs. Elastic tissue may be an almost structureless elastic membrane, or a finely reticulated tissue whose fibres cross and anastomose at every variety of angle. Examples of the latter are the lung tissue and the tissue of the vocal cords. The neck ligaments of the browsing animals, as the sheep and ox, have another variety of elastic tissue, with thick flattened fibres branching and forming a network. See also Connective Tissue.

ELASTI'CITY. When the form of a body is affected by the pressure of another extraneous to it the reacting force by which it sustains or tends to remove that pressure is its elasticity. The cause of elasticity belongs to the theory of molecularity; its effects in aggregate masses, to mechanics.

The equilibrium of the molecules of solid bodies is almost completely dependent on their own mutual actions, and on the quantity of heat. When heat is applied to a solid elastic body, that is, when its temperature is raised, the particles seek a different position of equilibrium more remote from each other than before. But while this heat is much below that necessary for friction, or for destroying the fibrous formation of organized matter, the stability of the removable particles is but little affected, and experiment shows that there is scarcely any change of elasticity. In fluids the compressibility obtains a greater range, while in gases, where no countervailing force of attraction is sensible, the increase of temperature is accompanied by a proportional increase of elastic force.

Among bodies whose elasticity is very apparent, we may enumerate glass, ivory, caoutchouc, sponge, and fibrous substances, as beams, muscles, and artificial webs, some gums, steel, and all the gases and vapours. In gases and vapours its effects may be produced to any extent, but they are limited in solids by their softness and facility of fusion, as in wax, lead, &c.; by their absorption of moisture, as in clay, feathers, catgut, straw; or by their friability, as in glass, dry resins, and copper or iron which have been exposed to a stream of ammoniacal gas.

When a uniform elastic string is suspended vertically it will be stretched by its own weight. The tension varies from point to point, and is everywhere proportional to the portion of the string of which it supports the weight.

When an elastic spring, fixed at one end, is bent by a weight or other force applied at a given point, the elasticity of inflexion acts normally at each point of the curve, and is some function of the curvature at the point. It is usual to suppose it proportional to the simple curvature. On this supposition the figure of an elastic lamina in a vertical position, fixed at its lower point and bent by a small weight applied at the top, may be determined. This problem has been treated by Euler, Lagrange, and Poisson. The English reader may find the varieties of the elastic curve discussed in the appendix to Whewell's "Mechanics."

The elastic force of a twisted string follows a law precisely similar to that of one which is only stretched; the latter is proportional to the extension, the former to the torsion. Thus, if a cylindrical elastic thread, fixed at one extremity, be twisted by a force applied perpendicularly to its length, any straight line taken along the surface of the cylinder will be converted into a helix; and with a double torsion the circular arc through which each point has been removed from its original place is doubled. And since the circular arc may be subdivided into any number of equal arcs, the successive resistances of the elasticity to the additional torsions are equal, supposing each preceding resistance to be sustained. Therefore the accumulated force of torsion is proportional to the angle through which an index would move if fixed at any point perpendicular to the length of the cylinder, or in the prolongation of its radius. But this law has limits as well as that for the elasticity of extension; for the torsion may be continued until a strain is produced, when there will of course be an accompanying diminution of elastic force. [See Torsion.] For the application of this principle to the measurement of electrical force see Coulomb.

The range of the elastic force of fluids, in consequence of their great resistance to compression, is extremely limited, and therefore few ordinary phenomena of nature are dependent on this cause. The great pressure at considerable depths in the ocean must produce a corresponding increase of density in the lower strata, if it is not in a great measure compensated by the increase of temperature.

There exists one simple and uniform law for the elastic forces of dry air and all the gases. From the experiments of Boyle, Mariotte, and Dalton, it is established that the elasticity, which is proportional to the pressure, is inversely as the volume, and therefore directly as the density, when the temperature is constant.

But an increase of temperature produces an increase of the elastic force of gases; or, which is the same, under a given pressure it expands the gas into a greater volume. Between the temperature of melting ice and boiling water this increase of volume is proportional sensibly to the additional temperature, measured by a mercurial thermometer, as was well established by the experiments of Gay-Lussac.

When a space is saturated with aqueous vapour or steam the elasticity remains the same when the volume is diminished, the only effect of compression being to convert the surplus portion into water. The contrary holds generally in gases, since their elasticity is inversely as their volume; but it is probable that with very high pressures, such as were used by Faraday to liquefy carbonic acid gas, there exists a limit for each, beyond which it is impossible to render them more elastic by compression.

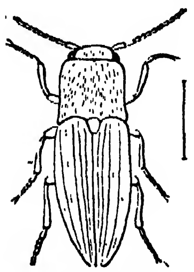
The elastic force of steam is found to increase nearly in a geometrical progression when the temperature is increased

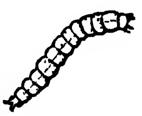
in an arithmetical progression, from which property steam has now become a great mechanical agent.

When vapours are mixed with each other at the same temperature and in the same space, the elastic force of the compound is the sum of the separate elasticities, provided this sum is not sufficiently great to render any of the vapours liquid, and provided these vapours have no chemical affinity.

ELATE'A. See PHOCIS.

ELATER'IDÆ is a family of beetles belonging to the section STERNOXI. The insects of this family are of a lengthened form; the head is, in nearly all cases, deeply inserted into the thorax; the thorax is usually of the same width as the elytra, or nearly so, longer than broad, and the posterior angles are acute, and most frequently produced into a pointed spine-like process; the elytra are long and narrow, cover the abdomen, and their external margins are often nearly parallel. The antennæ are of moderate length, either thread-like, serrated, or comb-like, and when


Agriotes lineatus.


Larva of Campylus linearis.

the insect is at rest they are deposited in two grooves on the under side of the thorax; at least such is the case in very many of the species. The legs are short and rather slender, and the femora and tibiæ are generally compressed.

These beetles are found upon flowers and upon the leaves of trees and plants; some species, however, are most frequently met with upon the ground. They are tolerably abundant in temperate countries, and are well known in Britain, where they bear the name of Skip-jacks or Click-beetles.

When upon any elevated situation, if approached they apply the legs and antennæ close to the body, and allow themselves to fall to the ground; if they fall upon their back they regain their natural position by a leap, which is always accompanied by a snapping noise similar to that which may be made by the finger-nails. When about to leap they bend the thorax backwards, so that the body is arched, or rather forms an angle, the insect then resting upon the apex of the abdomen and the fore part of the thorax. The leap appears to be effected by the sudden relaxation of the muscular effort which kept the thorax bent backwards, there being a peculiarity in its structure which causes it to spring forwards. There is a strong spine on the under part of the thorax, at its base, which, when the thorax is in its usual position, is deposited in a groove, and this plays an important part in the leap and brings the joints together after the strain.

The larvæ of the Elateridæ, of which the dreaded WIRE-WORM is one, feed most commonly upon vegetable substances; rotten wood affords food to many; others live in the ground, and feed upon the roots of plants; some of them attack the roots of wheat, and when numerous do much injury. These larvæ have long, rather slender, generally cylindrical bodies. Some of the Elateridæ are luminous. The light is emitted from two tubercles on the prothorax, which protect vesicles of phosphorescent substance. According to Mr. Gosse's observations of a species of Pyrophorus found in Jamaica, the light from the two thoracic tubercles is visible even in broad daylight when the insect is disturbed. When the beetle is handled these spots, previously of a dull white hue, gradually brighten up, the centre of each tubercle first showing a point of light, which in a moment spreads to the circumference, and increases in brilliancy till it blazes with a dazzling lustre. This light is of a yellow green. The fire-fly of the West Indies and South America (*Pyrophorus noctilucus*) belongs to the same genus. In some parts of South America the ladies use them for adorning their hair or their robes by inclosing them alive within a thin gauze work.

ELAT'ERIN, the active principle of elaterium, a product obtained from the fruit of the squirting cucumber (*Ecballium Elaterium*). Elaterium is a feculent matter deposited from the juice of the fruit, and much used in medicine. Elaterin is extracted from this substance by boiling alcohol, in which it is very soluble, and precipitated from solution by water, in which it is insoluble. It is obtained as a colourless crystalline powder, having the formula $C_{20}H_{14}O_4$. It has emetic properties, and is one of the most powerful purgatives known, acting efficiently in one-sixteenth grain doses.

ELATE'RIUM is the sediment deposited by the juice of the fruit of the squirting cucumber. It is the most powerful hydragogue cathartic known, the usual dose being one-sixteenth to half a grain. In dropsical affections, especially when connected with disease of the heart, it is valuable; and also in apoplexy to relieve plethora, but its use requires caution.

The squirting cucumber is a small perennial herb with a prostrate stem and cordate three-lobed leaves. The flowers are yellow, the male several together in a raceme, the female usually solitary, from the same axil as the male. The calyx is divided into five segments, without scales at the bottom, with a short tube in the male flowers, and adherent to the ovary in the female. The corolla has a short tube and five widely spreading segments. In the male flowers there are three stamens, with short, free filaments; one anther is one-celled, the others have two flexuose cells along the edge of a dilated connective. The fruit is 1½ to 2¼ inches long, pale yellowish-green, covered with papillæ, ending in hair-like points; the seeds are immersed in a watery juice, which gradually collects in the interior, and when the fruit is ripe causes it to burst, breaking away from the stalk, and scattering the seeds to a considerable distance. As it is from this watery juice that the elaterium is deposited, the fruit must be gathered before it is quite ripe. The sediment is poured on a linen filter, and dried on porous tiles with a gentle heat. The squirting cucumber has been cultivated in England since the middle of the sixteenth century. It is a native of the South of Europe and Western Asia.

ELATIN'EÆ, an order of plants belonging to the POLYPETALÆ, cohort Guttiferales. There are twenty species, found in marshy places and under water in all parts of the globe. Elatine has six species. *Elatine Hydropiper* (water-pepper) grows under water, and is very common in ground subject to inundations throughout France. It is also distributed throughout the greater part of Europe, but is a very rare plant in the British Isles, and has been found only near Farnham, in Anglesea, and Lough Neagh and the Lagan Canal, in Ireland. *Elatine hexandra* is a minute plant forming small matted tufts under water, and is distributed throughout most of Europe, but is rare in the British Isles. In this genus the sepals are two to four, acute, membranous; the petals are two to four; the fruit is a membranous capsule, and the plants are herbs without hairs. The other genus, Bergia, contains fourteen species, and differs from Elatine in the parts of the flowers being generally in fives; the sepals are obtuse, and the capsule is somewhat crustaceous.

This order is distinguished from others of the same cohort chiefly by the flowers being hermaphrodite; the stamens as many or twice as many as the petals; the leaves opposite or verticillate, small, undivided, stipulate.

EL'BA (the *Αἰθαλία* of the Greeks and the *Ilva* of the Romans), a small island in the Mediterranean, divided from Tuscany by the channel of Piombino, which is 5 miles wide at the narrowest part. The shape of Elba is very irregular. Its greatest length is about 18 miles, and its greatest breadth about 10 miles. The area is about 154 square miles. The island is mountainous. The highest summit, Monte Capanne, in its west part, is 3304 feet above the sea. The vine, the olive, the mulberry, and other fruit trees flourish; wheat, maize, vegetables, and water-melons are grown. Wine, both white and red, is made. Horned cattle and horses are scarce; sheep, goats, pigs, and asses are numerous. Fish is plentiful, and the tunny fishery yields a considerable profit. Salt is made at various places along the coast. Elba has rich iron mines, which were worked in the time of the Romans. Owing to the scarcity of fuel the ore is taken to the mainland to be smelted. The other mineral products are loadstone, alum, vitriol, and marble. The population of Elba is about 22,000. Porto Ferrajo is the capital and residence of the governor, and has 6000 inhabitants. From Porto Ferrajo a good road, 5 miles in length, made by Napoleon, leads to Porto Longone, a small fortress and harbour on the east coast. Of the other villages the most important is Rio, in the north-east part of the island and near the famous iron mines. Napoleon Bonaparte resided in Porto Ferrajo after his first abdication, from May, 1814, to the 26th of February, 1815, when he sailed for Cannes. After that time Elba was annexed to the grand-duchy of Tuscany, and now belongs to the kingdom of Italy.

ELBE (the *Albis* of the Romans and the *Labe* of the Bohemians), one of the largest rivers in Europe, rises in 50° 46′ N. lat. and 15° 32′ E. lon., on the western side of the Schneekoppe, one of the highest of the Riesengebirge Mountains, in the north of Bohemia, and runs in a general southern course as far as Pardubitz, in the circle of Chrudim, where, increased by the Chrudimka, it takes a westerly direction to the town of Kölin. In this part of its course it is joined by the Dobrowa. From Kolin the Elbe runs N.W. past Podiebrad; below this town it again pursues a course due west past Brandeis (above which it receives the Iser and Elbe-Kosteletz) to Melnik, where it is increased by the Moldau, and from which place it has unobstructed navigation to its mouth. From Melnik it has a tortuous course, generally towards N.W., to about 14° E. lon., and is joined by the Eger a few miles above the town of Leitmeritz. From this place it flows northwards to Aussig, takes a winding north-easterly course past Tetschen, where it receives the Pulsnitz, bends gradually north-westwards, quits Bohemia near Herrnskretschen by the wild narrow pass between the Erz and the Lausitz Mountains, and enters the kingdom of Saxony. At this point the Elbe is 335 feet in width. It thence takes a north-westerly course past Schandau, Pirna, Dresden, and Meissen, and enters Prussian Saxony about 7 miles above Mühlberg. From Mühlberg its course is north-westerly past Torgau to Wittenberg, above which it receives the Schwarze Elster; here it takes a westerly direction, leaves Prussia proper, traverses the duchy of Anhalt, during its passage through which it receives the Saale and Mulde. and re-entering Prussia above Aachen, flows on to Magdeburg, whence it runs N. by E., receiving the Ohre on its left bank, and continues in the same direction until it reaches the point below Sandow, where it is joined by the Havel. Here it again has a north-westerly direction, crosses Brandenburg, which it separates for a few miles from Hanover; thence it separates Hanover from Mecklenburg, until it enters the north-eastern districts of the former. After traversing them as far as Boitzenburg, it divides the Hanoverian provinces from the duchies of Lauenburg and Holstein and the Hamburg territory, all now belonging to Prussia, until it discharges itself into the North Sea. From Hamburg and Altona downwards to Glückstadt in Holstein, and then to the North Sea, it becomes navigable for ships of heavy burden. Its mouth lies north of Cuxhaven, about 85 miles below Hamburg.

The whole length of the Elbe is about 710 miles, and it is navigable for about 470 miles. Its mean depth is 10 feet, and its average breadth 900 feet, but it widens at some points to 1000 feet and more, and near its mouth to several miles. The navigation of the river below Hamburg is slightly difficult, on account of the number of islands and sandbanks that occur in this part of its course. By the Moldau, which is navigable as far as Budweis, and the railway from this town to Linz in Upper Austria, the Elbe is connected with the Danube; it has communication also with the Oder by the Havel and the connecting canals. The benefits derivable from the navigation of this river were formerly very much curtailed, and are still so to some extent, owing to the duties levied by the several states through which it flows. This river is well stocked with fish, particularly salmon, eels, and sturgeons.

The marshes of Friesland, the sandflats of Holstein, and the estuary of the Elbe were the birthplace of the Saxons, the Angles, who lived immediately south of the Jutes, being to the north of the Saxons, in Sleswig. All three tribes, however, bore the name of *Englisc* among themselves and their land was Engla-land. The Romans called them Saxons, knowing only that southernmost division which dwelt around the Elbe (whence our absurd term Anglo-Saxons). Here, then, was the historic seat of our race in the fifth century—soon to cross the seas and found a new and greater England in the far off island of Britain.

EL'BERFELD, a large manufacturing town in the Düsseldorf government of the Prussian Rhine Province, is 17 miles by railway E. from Düsseldorf, and has 93,538 inhabitants. It is a long straggling town running along both sides of the Wupper, which here flows through a narrow valley. The modern parts are well built and paved, but a portion of the town is composed of irregular, narrow, and dirty streets. Here and there are seen spacious houses fronted with cut stone and in the best architectural styles. The river is a most disgusting object, being the receptacle for the sewage and the offscourings of the numerous dyeing establishments of the town. The waters of the Wupper, however, are said to possess most valuable bleaching properties, and to this circumstance Elberfeld is indebted for its origin and prosperity. The town is the seat of an extensive cotton and silk manufacture, but is more important still for its dyeing, printing, and bleaching establishments. The cotton printers and silk-dyers consume a large quantity of piece-goods that are woven by hand in the surrounding districts; their patterns, which are very superior, are designed on the premises of the large printers, who keep artists at high salaries in their employ. Merinos and fancy woollen goods are also manufactured here. The town has numerous dyeing establishments, bleaching grounds, cotton-spinning factories, and a large woollen mill, with machine makers and colour works; it has also block-pattern cutting, printing, engraving, and lithographic printing establishments. Tapes and ribbons are important articles of manufacture, with which this town and Barmen (which touches Elberfeld on the northern extremity) supply all Germany. The colour called turkey-red is produced in Elberfeld more cheaply, and of better hue, than in any other place in Europe. Of the public buildings the Roman Catholic church, which is in the Byzantine style, and the guild-hall, in the great room of which is a beautiful frieze painted by the artists of the Düsseldorf school of painting, are the most remark-

able. The town has a gymnasium, a museum, several banks, orphan asylums, and hospitals, and a great number of educational establishments. Among these last is one for young manufacturers and the managers of factories, in which the mechanical processes in the construction of the jacquard-loom cards, and the calculations accompanying them in weaving, are taught, as well as pattern-drawing. This establishment, one of great efficiency and importance, is supported by the town, which also maintains its own poor by means of a rate.

EL'BERICH (*Ælfric*), the most famous of the many dwarfs who people mediæval German romances. He was father of the Emperor Ortnit in one of the legends, and gave him the undaunted courage and the wonderful silver armour which enabled him to gain the throne of the world. But first he sailed with Ortnit to the Holy Land, assisted him to capture the beautiful Sidrat, and defeat the paynim Machorell her father. Sidrat on her marriage became a Christian with the name of Liebgart. He figures also in the myth of Wolfdieterich and the dragon—one of those many dragon stories rife in all lands. Finally, Elberich is found in the great Teutonic epic, the Nibelungenlied. He and his dwarfs guard the treasure of the Nibelungs, land of magic; they forge the priceless sword Balmung, earned honourably by the hero Siegfried. After the death of the Nibelung kings and Siegfried's election as their successor the dwarfs oppose the hero, Elberich at their head in cap of darkness. Nevertheless Siegfried overcomes Elberich. Generously he spares him, and the grateful dwarf-king gives him the cap of darkness as his guerdon, yielding up, moreover, the custody of the Nibelung hoard.

ELBEUF, a large manufacturing town in the department of Seine-Inférieure in France, stands in a beautiful valley on the left bank of the Seine, at a distance of 78 miles N.W. from Paris and 13 S.S.W. from Rouen. The population in 1882 was 22,806, but if the surrounding suburbs, in which most of the work-people reside, are included the number amounts to 40,000. The town is in general ill built, ill laid out, and badly paved; but in modern times many improvements have been made. A great number of large factories and handsome edifices have been erected, the quays extended, the old streets widened, and a spacious *champ de foire*, or market-place, with side avenues planted with chestnut trees, has been constructed. The streets are lighted with gas, and the town is well supplied with water from eight Artesian wells, one of which feeds six public fountains. The most remarkable public buildings in Elbeuf are the churches of St. Etienne and St. Jean Baptiste, the interiors of which are richly decorated and lighted by fine painted windows.

Elbeuf has a tribunal, a chamber of commerce, and a *conseil des prud'hommes*, or council of experienced men, for the settlement of questions between manufacturers and their workmen. [See PRUD'HOMMES, CONSEIL DES.] The factories of the town and neighbourhood, which exceed 200 in number, and are mostly worked by steam-power, produce a great quantity of woollen cloths; the descriptions are various, and include double-milled and waterproof cloths, zephyrs, and fancy cloths of all colours. This town is also celebrated for the manufacture of billiard-table cloth and flannel. It contains several dye-houses, fulling-mills, and large wool-stores, besides establishments for washing wool, which lie along the Seine and the Puchot, a small winding stream that traverses the town. Its woollen manufactories are so extensive that it has been called the Leeds of France. Elbeuf has daily communication with Rouen, Paris, and Havre by steamboats, and with Paris by the Paris and Rouen Railway.

Elbeuf is said to have existed in the ninth century, but its origin is uncertain. During the administration of Colbert, its manufactures were in a comparatively flourishing state, but they were almost ruined at the revocation of the Edict of Nantes, and did not again revive until after the Revolution.

EL'BING, a large commercial and manufacturing town of Prussia, in the government and 34 miles E.S.E. of Dantzic, on the river Elbing, which is joined to the Nogat by a canal. The town consists of an old and a new town, with numerous suburbs. It contains several churches, chiefly evangelical, a synagogue, an exchange, bonding warehouses, a gymnasium, sugar refineries, several schools and asylums, and a population, including the suburbs, of 35,842. Tobacco, sailcloth, soap, hosiery, linen, oil, &c., are manufactured; there are also tanyards and shipbuilding yards. The chief exports are corn, hemp, flax, staves, timber, butter, and wool. Some sea-going vessels, besides a great number of small craft, belong to the town, which has a large transit trade with Pillau, at the entrance of the Frische Haff.

ELBOW. See ARM.

ELBURZ', MOUNT, the loftiest peak of the CAUCASUS, said to be 18,500 feet above the sea. Also the name given to a portion of the Hindu-Kush range, south of the Caspian, culminating in Demavend, 21,500 feet high. The range rises very steeply off the plains of North Persia, reaching a height of 8000 feet in a distance of 5 or 6 miles. The sides fronting the arid plains are rocky and sparsely timbered; the north sides towards the Caspian are very thickly wooded, the principal trees being the oak, beech, walnut, plane, box, ash, and poplar. Hidden in these the valleys and villages are the resort of many nomads. The passes are about 12,200 feet high, and the main watershed 10,000 feet.

EL'DER (literally "an old man") was a title originally given among the Hebrews to such as by reason of age and experience were appointed to act as magistrates, &c. It was afterwards given to the holders of such offices, irrespective of their age, and became a recognized official title, as the kindred term alderman has become in England. The elders of Israel were evidently instituted at a very early period, for it was to them that Moses declared his commission on his return from Midian (Exod. iv. 29), and seventy elders were chosen to assist him in his administration during the journey through the wilderness (Num. xi. 16, 17). When the people became settled in Palestine the elders appear to have sustained, without, perhaps, any precise definition of their functions, such offices as that of representative of the people, district governors, and local magistrates. The order survived all the vicissitudes of the history of the Hebrews up to the time of Christ, when the elders had become a part of the important council of the Sanhedrim.

In the New Testament the *elder* or *presbyteros* is mentioned frequently in connection with the Christian church. The exact meaning and definition of the term is the main subject in the standing controversy between Episcopalians and Presbyterians. It is admitted by all parties that it designates all who were set apart for the pastoral office, but for the details of the controversy the reader is referred to the articles BISHOP and PRESBYTERIANISM. The ordinary use of the term is now limited to the Presbyterian churches, and though, according to their theory of church government, there are two classes of elders, teachers and administrators, the title when used alone signifies only the latter. It is the duty of the elder to generally assist the minister in the duties of supervision, admonition, sick visitation, and in the examination of candidates for admission to the communion service. In the courts and assemblies of the Presbyterian churches the elders sit and vote with the ministers on all questions.

EL'DER (*Sambucus*, from the Gr. *sambuкē*, an ancient musical instrument resembling a harp) is a genus of plants of the order CAPRIFOLIACEÆ. The Common Elder (*Sambucus nigra*), a native of Europe and North Africa, grows with extraordinary rapidity, and is distinguished by

the rich fulness of its robust shoots. The berries are largely employed in the United Kingdom for making elder wine. The flowers are used in fomentations, and in a medicinal tea. They are gently stimulant and sudorific. The leaves, on account of their disagreeable odour when bruised, are supposed to keep off insects, and a decoction of them has been recommended to preserve young plants from the ravages of caterpillars. The white, tough, close-grained wood, being easily cut, is much used as a cheap substitute for boxwood in the mechanical arts. Carpenters' rules, shuttles for weaving, articles of turnery, shoemakers' pegs, &c., are made of it. *Sambucus Ebulus* (dwarf elder or Danewort), a native of Europe and North Africa, is not an uncommon plant in England and Scotland in way-sides and waste places. It has a very fetid smell, and the roots are violently purgative. *Sambucus canadensis* (Canadian elder) is a native of North America, and extends from Canada to the Carolinas. Its uses and properties are similar to those of *Sambucus nigra*. *Sambucus racemosa* (red-berried elder) inhabits the south of Europe and Siberia. It is a showy plant, and has a splendid appearance when covered with its fine large scarlet fruit.

ELDON, EARL OF (JOHN SCOTT), was the son of William Scott, of Newcastle-upon-Tyne, who followed the business of what is called a coal-fitter or factor, in which he acquired considerable wealth. John was the eighth child by a second marriage. The eldest son was William, born in 1745, who became LORD STOWELL. John was born on 4th June, 1751, and after proceeding through the royal grammar-school of his native town, he was sent to Oxford (whither his brother William had preceded him) in May, 1766. He was entered a student of the Middle Temple in January, 1773, and was called to the bar in 1776.

His progress was slow, but at length an election case (that of Clitheroe in 1780) established his reputation, and his practice from that time increased rapidly. His income from professional fees rose to £6000 in 1785, and to £12,000 in 1790. In 1783 he was returned to Parliament for the borough of Weobly. He and Erskine, on opposite sides, made their maiden speeches in the same debate—that on 20th November, on a motion connected with the famous India Bill, which eventually upset Fox's government.

In March, 1787, Scott was appointed chancellor of the bishopric and county palatine of Durham, and in June, 1788, the office of solicitor-general was conferred on him. At the same time he was also knighted. He held the office of solicitor-general till February, 1793, when he was made attorney-general on the promotion of Sir Alexander Macdonald to the place of chief baron of the exchequer.

The period of Sir John Scott's tenure of the office of attorney-general extends to the year 1799, and is memorable for the state trials connected with the political excitement produced in this country by the breaking out of the French Revolution. Muir, Palmer, Skirving, Margarot, and Gerald had all been convicted of sedition in Scotland and sentenced to fourteen years' transportation, when in October, 1794, Hardy, Horne Tooke, Thelwall, Holcroft, and their associates were indicted for high treason at the Old Bailey. Only Hardy, Tooke, and Thelwall were tried; all three were acquitted, and the prosecutions against the other prisoners were dropped. The proceedings, although conducted with moderation and good temper, involved the attorney-general in a considerable degree of odium, contrasting very unfavourably with the growing popularity of his brilliant rival Erskine.

In July, 1799, on the death of Sir James Eyre, chief-justice of the common pleas, Sir John Scott claimed and obtained that office, agreeing at the same time to go into the House of Lords as Baron Eldon, the name of a manor in Durham which he had bought about five years before.

On Lord Loughborough's resignation of the great seal in April, 1801, about a month after Mr. Pitt had been succeeded as prime minister by Mr. Addington, Lord Eldon became lord chancellor on 14th April. He continued to hold this office till 7th February, 1806, when, on the accession of the Whig ministry of Mr. Fox and Lord Grenville, he was succeeded by Lord Erskine. He resumed it on 1st April, 1807, on the return of his party to power; and he finally resigned it on the 30th April, 1827, when Mr. Canning became prime minister, and the great seal was given to Lord Lyndhurst.

During nearly all the time that Lord Eldon sat on the woolsack he took a leading part in the general debates in the House of Lords. He was a very talented and sagacious judge, and although his notorious dilatoriness frequently inflicted great injustice upon suitors, his numerous judgments, which fill quite a small library, are of much value and authority. He was less conspicuous as a statesman, and his name is not associated with any measure of public importance. He was a stanch defender of high church and extreme Tory principles; and the two great measures of parliamentary reform and Roman Catholic emancipation in particular were steadily opposed by him on all occasions, and to the last. Lord Eldon survived in retirement till the 13th January, 1838.

EL DORA'DO (literally "the golden country") was the name given by the Spaniards in the sixteenth century to an imaginary region somewhere in the interior of South America, between the Orinoco and the Amazon, where gold and precious stones were supposed to be in such abundance as to be had for merely picking them up. This story was communicated by an Indian cacique to Gonzalo Pizarro, brother of the conqueror, who sent Francisco Orellana down the Amazon River to discover this wonderful land. Orellana followed the course of the Amazon down to the sea, but he did not find El Dorado. The story, however, continued to be credited for many years afterwards, and Raleigh was so persuaded, or pretended to be so persuaded, of the existence of this wonderful country, that he fitted out more than one expedition for the purpose of discovering and conquering it for England. [See RALEIGH.] It is now the popular name for the district in the north-east of California in which the first discovery of gold in that state was made.

ELEAT'IC PHILOSOPHY has its name from Elêa, a Grecian colony on the western coast of Lower Italy, where Xenophanes of Colophon settled in his old age (about 540 B.C.) and founded a school distinguished by its bold attempt to construct a system of the universe upon metaphysical principles. Xenophanes preached in glowing verses bitter sarcasm of the polytheism of Greece. He recited his splendid poems in praise of the one perfect God, self-existent and intelligent. Enough remains to make us long for more. [See XENOPHANES.] He identified God with nature, or rather he did not separate the deity; he may therefore, with great reserve, in some sense be styled a pantheist. Xenophanes was very poor; his pupil and successor, Parmenides, was wealthy, splendidly generous, and powerful. Parmenides added to the body of doctrine; and among other things conceived that the physical universe might be explained by the union of heat or of cold, with moisture or dryness. Thus heat and moisture gave *air*; heat and dryness, *fire*; cold and moisture, *water*; cold and dryness, *earth*. The school also reckons among its members Zeno of Elêa, Melissus, and in some points Empedocles.

Zeno was the teacher of Pericles, and further was the inventor of the famous weapon, afterwards familiarized to us by Socrates, the dialectic method of inquiry. When Zeno went to Athens he had to combat the one-substance doctrines of the Ionian school, and he did this through proving them absurd by skilful cross-questioning of his opponent. For his thorough-going monotheism and devotion to the

One, see the article under his name. From Zeno's method, but not from Zeno himself, rose the Sophists and the Sceptics.

EL'ECAMPANE, the herbalists' name of the plant called *Inula Helenium.* It is esteemed as a grateful stomachic. Its leaves are aromatic and bitter, but its root much more so. It is expectorant and stimulating, and is employed in debility of the stomach, but is not much used. It is used in Europe to flavour certain sorts of confectionery which bear its name; and it enters into the composition of several continental carminatives. It contains a white amylaceous matter called *inulin.* Elecampane is an indigenous, perennial, herbaceous plant, found in moist meadows.

Inula is a genus belonging to the order COMPOSITÆ. The anthers have two bristles at their base; the fruit has hair-like pappus in one row; the receptacle is without scales; the involucral bracts are imbricate in many rows. *Inula Helenium* has large heads of flowers with leafy involucral bracts, four-angled fruits, large toothed leaves, downy beneath, and stem 3 or 4 feet high.

ELECTOR. The office of Cæsar was in theory open to the humblest Roman citizen, and the German Empire, formed upon the same model, became in like manner elective after the accession of Konrad I. in 911. The choice of emperor was intrusted to seven great feudatories —the King of Bohemia, the Duke of Saxony, the Margrave of Brandenburg, the Count Palatine of the Rhine, and the Archbishops of Trier, Mainz, and Cologne; and these seven were known as the Electors. Several other electorates were subsequently added, such as Hanover, Brandenburg (Prussia), &c., and those of Mainz and Trier were set aside. The place of election was Frankfurt on the Main, and the choice was commonly the heir or a relative of the late emperor. The office was abolished in 1803, but in one instance, that of Hesse-Cassel, the title was held until 1866. The *electoral crown* or *cap* was a scarlet cap, turned up with ermine, worn by the electors of the empire.

ELEC'TRA, mother of Dardanus by Zeus, in the Greek myth, was one of the seven sisters, daughters of Atlas, who form the star-group of the Pleiades. When the town fell that her son had founded (ancient Troy) Electra tore her hair for grief, which blazing behind with starry fire as she rushed through the heavens, a distracted *komêtês* (wanderer), spread out as the tail of the *comet* she had become. She is the "lost Pleiad" so often sung about. Undoubtedly one of the seven stars must have grown very faint after being equally brilliant with the rest; but it must have waxed since then, for now all seven can be seen in Taurus almost with the naked eye. (Telescopes show many others, fourteen of fair size.) See PLEIADES.

ELECTRA was also the name of the daughter of Agamemnon, and sister therefore of Orestes. She married his friend Pylades. For the legend about her see ORESTES. She forms the subject of master pieces by three of the great Greek dramatists—the *Choëphori* of Æschylus and the *Electras* of Sophocles and Euripides.

ELEC'TRIC CAL'AMINE is a native silicate of zinc ($2ZnO, SiO_2+H_2O$), generally called *Hemimorphite* and sometimes *Smithsonite* by English writers; in America it is called *Calamine*, a name used in England to denote the carbonate of zinc, which in America is known as Smithsonite. Its hardness is 4·5 to 5; specific gravity varies from 3·16 to 3·9. When crystallized it is white or colourless; the massive varieties are generally white or yellowish-white, but sometimes light blue or green. The crystals (which belong to the rhombic system) exhibit the curious phenomenon of *hemimorphism* (whence the name hemimorphite), that is, they are differently terminated at the two extremities. A consequence of this peculiarity of structure is that the mineral is *pyro-electric*, that is, becomes electrified on heating and exhibits different electric states of the two ends; it is to this property that it owes its name of *electric calamine.* The mineral is found at Roughton Gill and Alston in Cumberland, Matlock in Derbyshire, Wanlockhead in Dumfriesshire, Altenberg near Aix-la-Chapelle, Moresnet in Belgium, Nertschinsk in Asiatic Russia, and Phœnixville in Pennsylvania. It is used as a source of zinc.

ELECTRIC CAT-FISH (*Malapterurus electricus*) is a fish belonging to the family Siluridæ (CAT-FISHES), remarkable for the possession of an electric organ; this fish is found in the Nile. The generic name (Gr. *malakos*, soft; *pteron*, fin; *oura*, tail) refers to the fact that the single dorsal fin is fatty and placed just before the rounded tail-fin or caudal. The ventral fins are six-rayed, and are placed somewhat behind the middle of the body. The pectoral fins are without the sharp spine which is characteristic of most of the Siluridæ. The jaws carry six barbels, and the palate has no teeth. The eyes are small. The gill-opening is very narrow. The whole body is covered with soft skin, and is speckled with small round black spots. The electric organ extends over the whole body, but is thickest on the abdomen. It is placed below the external skin, and "consists of rhomboidal cells, which contain a rather firm gelatinous substance. The electric nerve takes its origin from the spinal cord, does not enter into connection with ganglia, and consists of a single enormously-strong primitive fibre, which distributes its branches in the electric organ" (Günther). The flesh of the electric cat-fish is eaten, and the electric organ is thought to possess great healing virtue, being burned and the fumes inhaled. Two other species of this genus are found in the fresh waters of tropical Africa, neither of which possess the electric organ.

ELECTRIC EEL (*Gymnotus electricus*), the most powerful of electric fishes, belongs to the same suborder (Apoda) of the Physostomi as the common eel, but to a different family, GYMNOTIDÆ. This fish has a long, nearly cylindrical, and serpent-like body. The caudal and dorsal fins are absent, and the anal fin extends to the end of the tail. The body is quite destitute of scales. The teeth are conical, arrayed in a single row. The eyes are exceedingly small. Its colour is brownish-black. The electric eel is a fresh-water fish, and in the rivers of South America attains a length of 5 or 6 feet. The electric organ occupies about half the thickness of the tail, and is divisible into four longitudinal bundles, a thicker upper pair and a slender lower pair laid along the base of the anal fin. Each bundle is constructed of parallel membranes and horizontal discs, close to each other, including multitudes of transverse prismatic cells filled with gelatinous matter, and largely supplied with nervous filaments. This organ, when fully vigorous, gives a shock powerful enough to affect the strongest animal, paralyzing horses and killing fishes and small animals on which the eel subsists. Humboldt's account of the capture of these eels for food by the Indians is very graphic and interesting. The Indians, he says, well aware of the danger of encountering them when their powers are in vigour, collect from twenty to thirty horses, drive them into the pools, and when the eels have exhausted their electric batteries on the poor horses, they can be taken without risk. Time and repose are needed before the batteries are ready to act again. The horses at first exhibit much agitation and terror, but are prevented from leaving the ponds by an encircling band of Indians, who strike them with bamboos. Several horses succumb, and are drowned; but after about a quarter of an hour the electric eels lose their power and make for the shore, when they are captured by the Indians with harpoons. As this account has not been verified by later travellers, Dr. Günther regards it as resting "either on the imagination of some person who told it to the great traveller, or on some isolated incident."

ELECTRIC LIGHTING. The subject of electric lighting began about 1880 to receive an increasing amount of attention from many of our most scientific and practical men, public interest was universally awakened regarding it, and the patent office was inundated with specifications and applications all more or less proposing to give us perfect electric lighting. Numerous companies were then formed, with large subscribed and still larger nominal capital, with a view, in some instances, only to sell patents and patent-rights; in others, with the more honourable and honest purpose of making and installing their appliances, each one claiming its speciality or system to be the best either as a whole or in some particular feature.

Our leading scientific and engineering journals have frequently given descriptions of this or that dynamo and electric lamp, or of some special installation or electrical exhibition, using terms and electrical phraseology which to many must have appeared new and difficult to understand. Therefore, an explanation of these terms at the outset will enable the general reader to more thoroughly satisfy his desire for an intimate knowledge of the laws which the phenomena of electric lighting involve, and the methods of applying electric energy to the lighting of large spaces, workshops, houses, and steamers.

Units of Measurement.—The several practical units of measurement required in measuring electrical currents in connection with electric lighting, were finally determined upon at the International Congress of Electricians, Paris, 1881, and British Association, 1882. Electricity, by whatever means generated, is the result of the expenditure of energy (mechanical energy, as a rule, in the case of electric lighting), and as the measurement of energy involves *space*, *mass*, and *time*, the three fundamental units adopted were the centimetre for length, gramme for mass, and second for time, which is termed the centimetre-gramme-second system, or shortly the C.G.S. system; and upon these fundamental units all the practical electrical units of measurement are based.

An electric current may, for all practical purposes, be considered analogous to a fluid, under conditions somewhat similar to those by which water flows through a pipe.

Electro-motive Force compared to Head or Pressure.—The difference of level or pressure due to gravity between the top and bottom of the water pipe (fig. 1, Plate I.)—in other words, the "head"—causes the flow of water along the pipe, while the difference of potential or electrical pressure between the ends of copper wire (fig. 2)—in other words, the *electro-motive force*, as it is termed (E.M.F.)—causes the flow of electricity along the wire. The potential or pressure in both cases determines the power of doing work, as illustrated by the water flowing from the elevated tank through the pipe and driving the small water-wheel when the tap is turned; and by the electricity (generated by the battery or dynamo) flowing along the copper wire and driving the small electric engine or motor when the key is turned in the direction of the arrow. The pressure of the water is measured by pounds on the square inch, or by the difference of level in feet of the free surface of the water in the tank about the outlet at the bottom of the water pipe, generally termed the "head," while the electrical pressure is measured in *volts* (a contraction for Volta, the famous physicist who discovered, in 1786, voltaic electricity), one volt being 7 per cent. less than the electromotive force given by one good Daniell's cell [see BATTERY], or more exactly 10^8 C.G.S. units.

Electric Resistance Compared to Friction.—The *friction* generated between the running water and the inside of the pipe offers a certain amount of resistance to the flow of the water, and may be considered so far analogous to the *resistance* offered by the metallic conductor to the flow of the electricity along it. The friction between the water and the pipe is estimated by the equivalent loss of head in feet which it causes, while the electrical resistance is measured in *ohms* (a term commemorating the discoverer of the relation between current strength, electro-motive force, and resistance), one ohm being equal to the resistance offered by 240 feet of pure copper wire, No. 18, Board of Trade standard gauge ($\frac{1}{20}$ of an inch diameter), at 60° Fahr., or more exactly 10^9 C.G.S. units. The resistance of electric light copper conductors increases with temperature by 0·21 per cent. per degree Fahr., and varies directly as the length and inversely as the sectional area of the conductor.

Strength of Electric Current compared to Flow of Water.—The flow of the water through the water pipe, and the strength of the electric current along the conducting wire, are in each case determined by the pressure overcoming the resistance. The strength of electric currents is measured in *amperes* (in memory of Ampère, the propounder of the Amperian theory of electric currents, in 1821), one ampere being the current produced by the E.M.F. of one volt when acting on one ohm of resistance. One ampere is equal to 10^{-1} C.G.S units.

Ohm's law: $\text{Current} = \dfrac{\text{Electro-motive force}}{\text{Resistance}}$, or $C = \dfrac{E}{R}$;

using C as the symbol for current, E for electro-motive force, and R for resistance.

The Quantity of Electricity compared to the Volume of Discharge or Volume of Flow of the Water is in each case determined by the current passed in a second. The quantity of electricity flowing in any circuit is measured in *coulombs* (after Coulomb, the discoverer of the law of electric and magnetic attraction, and the inventor of the torsion balance). [See COULOMB.] One coulomb is equal to the quantity of electricity given by an ampere in a second or 10^{-1} C.G.S. units.

Power.—In order to estimate the power of the current developed in each case, we have simply to multiply the total pressure by the current passed per second. Mechanical power is measured in Great Britain by horse-power, or the power expended in elevating 33,000 lbs. 1 foot high in one minute. Electrical power is measured in *watts* (in memory of James Watt, the discoverer of the steam-engine). One watt is equal to one volt multiplied by one ampere, or $E \times C =$ watts; while 746 watts equal one British horse-power, or 33,000 foot-pounds per minute.

General Arrangement of Electric Lighting Systems.—Of these there are many modifications, but in most of them the following system of appliances is necessary:—(1) A producer of mechanical energy, (2) a dynamo or generator of electricity driven by it, (3) a system of wires conveying the electricity to (4) the lamps, where it is transformed into light. There is thus a complete cycle of changes. Taking the steam-engine as the motive power, the coal burned in the furnace produces heat, converted into mechanical energy in the steam-engine, which revolves the dynamo, converting the mechanical into electrical energy. This energy on reaching the lamps through the conductors is there concentrated on the carbon of the lamp, raising it to such a temperature that it gives forth light—heat in the furnace back to heat in the lamps with light, or molecular vibration from beginning to end, until a handy form of it is reached for the purposes required. At each change which takes place there is a certain loss, so that the value in energy units of the light in the lamp is only a small percentage of the energy produced in the furnace of the steam-engine boiler; yet nevertheless such has been the ingenuity and perseverance displayed by electricians and mechanicians within the past few years, that by certain systems of electric lighting we get a wonderful return in light for the quantity of coal burned in the furnace.

Motive Power for Driving Dynamos.—The most suitable machines for producing the mechanical power to be converted into electrical energy are the steam engine, the

gas engine, and the water-wheel or turbine. The force of the wind, as applied by the windmill, and the rise and fall of the tides have been proposed, but not yet put into practice. Whatever kind of machine is adopted, it is absolutely necessary that so long as the power developed by it is applied to driving a dynamo in direct circuit with the electric lamps, the motion should be as uniform as possible, in order to insure a steady current or electromotive force. For this purpose, in the case of the steam engine, it should be fitted with a sensitive and efficient governor, and it should be capable of easily furnishing the necessary power without in any way overstraining any of its parts, and be constructed of the very best materials and in the best possible manner, so as to minimize the chance of a break-down. In the case of workshops where there is an ample reserve of power developed by the shop engine, and the demand upon its energy does not alter very rapidly, it has been found suitable in many instances to drive the dynamo by means of the same; but this should not be attempted before carefully testing and considering well the capabilities of the engine.

The demand for electric lighting has necessitated a special class of engines for this work, and several well-known makers, notably Messrs. Marshall & Sons, Messrs. Tangye Brothers, Messrs. Mather & Platt, and Messrs. Alley & Maclellan, &c., have devoted much attention to this subject. The driving connection between the engine and the dynamo is usually carried out by means of belting, either direct from the flywheel to the dynamo pulley, or by the intervention of a counter shaft, frictional and toothed gearing being but sparingly employed.

It is only in the case of steamships, or where the space is limited, that the motion is communicated direct from the engine shaft to the dynamo, without the intervention of belting or gearing, and in such cases the engine must be run at a very high speed, or the dynamo be arranged to work at an abnormally slow rate, of which an example will be given further on.

Gas engines are becoming more popular, and by using a flywheel on the dynamo shaft, with long slack belting to counteract the effect of their somewhat irregular motion, they are, in many instances, found very serviceable. Sir William Thomson has adopted a 6 horse-power Clark's gas engine at his laboratory, and at Oxford University there is a 20 horse-power Otto gas engine driving the Pilsen Co.'s system, apparently with good effect.

Water power has, as yet, been but sparingly employed, either through the intervention of water-wheels or turbines, probably from the fact that where the electric light is in greatest demand water is not available; but from the ease with which it can be manipulated, it will be found quite as efficient as the best steam engine, and certainly will prove less costly.

Windmills and tidal machines are out of the question until that much-required desideratum, viz., the storage of electricity, can be economically effected.

The Theory, Construction, and Working of Dynamos or Electric Generators.—The modern dynamo-electric machine may be regarded as a combination of iron bars and copper wires, with certain parts fixed while others are rotated by the application of the mechanical power supplied by the steam engine, the gas engine, or the water-wheel in one or other of the methods already mentioned. How the relative movement of copper wires and iron bars generates electric currents is the difficulty which many fail to understand. (For further information consult "Electric Illumination," by Dredge, to which work we are indebted for some of the following illustrations.)

Consider the cases of a bar magnet and a copper wire with a current passing through it (figs. 3, 4, 5, 6, 7, 8, in Plate). The medium surrounding each is under a similar influence or stress, which may be easily rendered visible by a simple experiment. Lay a sheet of paper that has been previously soaked in melted paraffin wax above (fig. 3), and another on the end (fig. 4) of a bar magnet, with a third through a wire along which a current is passing (figs. 5, 6). Now sprinkle on these papers, from a pepper pot or gauze sieve, some fine iron filings; the filings are attracted to and lie in certain positions. Pass a hot copper bolt over the papers, keeping it about half an inch therefrom, and on removing the papers from the magnet and wire we shall have diagrams as shown, exhibiting the direction of the stresses of the medium surrounding the magnets and the wire, or, as it has been called, "the direction of the magnetic lines of force." It is not in the magnetic bar of steel or iron that we call a magnet, or in the copper wire, but in the space that surrounds these that we must search, in order to explain the following phenomena. The electric current passing through the wire (fig. 5) is the cause of magnetic lines of force in the medium surrounding it, quite as much as the magnet (fig. 4).

It is impossible to magnetize a magnet by whatever means without also magnetizing the space surrounding the magnet, and the space thus filled with the lines of force possesses properties which ordinary unmagnetized space does not possess. These lines give us definite information about the magnetic condition of the space where they are. Their direction indicates the direction of magnetic force, and their number the strength of the magnetic field. Wind a piece of copper wire into the form of a coil (fig. 7), and pass an electric current through it; the magnetic lines produced by it are naturally induced into the direction shown by the arrows, and the wire or helix has all the magnetic properties and behaviour of a bar magnet. Pass a piece of soft iron into the centre of this helix, and it immediately becomes strongly magnetized by the influence of the magnetic field surrounding the current-carrying wire. Fig. 8 represents an impression obtained in the way just described with the paraffined paper. This mode of producing a strong magnet is adopted in all the dynamo-electric machines. Faraday discovered that the converse of the above was true—viz., that when the pole of a magnet is moved into or out of a coil of wire the relative motion while it lasts produces a current; in fact relative motion between a completed or closed coil of wire and a magnet always produces a current. It is this fact that is so largely taken advantage of in the design of dynamo-electric machines.

Fig. 9 shows a single wire with its ends joined to a galvanometer, G. Being rotated between S and N, magnetic poles, a current is generated in the wire and passes as shown by the arrows. Fig. 10 is a number of wires similarly rotated, with the method of conveying away the current, by means of contact pieces and brushes (called a commutator), at the right moment and in the right direction, while fig. 11 gives a more complete view of this commutator as used in practice.

The following principles or general statements should be borne in mind:—

(*a*) To induce a current in a closed or continuous wire by means of a magnet, there must be relative motion between the wire and magnet.

(*b*) Approach of a magnet to a coil, or of a coil to a magnet, induces a current in the opposite direction to that induced by recession. See Voltaic Electricity for the direction of currents so caused.

(*c*) The stronger the magnetic field the stronger will be the electro-motive force induced in the coils.

(*d*) The more rapid the motion the stronger will be the electro-motive force.

(*e*) The greater the number of turns in the coil the stronger will be the electro-motive force induced in it.

(*f*) The stronger the magnetic field the greater will be the work required to move the coil through it.

To illustrate the general principle upon which direct current series dynamos are made, attention is called to fig. 12, Plate I., representing a section of a Gramme machine. For simplicity of explanation the armature, A, with its coils of wire, W W W, is shown revolving at right angles to its natural position in the machine. The arrows show the direction of winding on the electro-magnets, M M, in order to produce the polarity, N S. S represents a spindle carrying armature, A A, which revolves between the north and south poles, N S, of the electro-magnets, M M M M, around which the wire from the positive terminal of armature, T +, is wound as shown, until it joins C +, the positive or upper carbon of the arc lamp, T —, the negative terminal of armature being joined to C —, the negative or lower carbon of the arc lamp; B_1 B_2 are the brushes which collect the current from the commutator, C, whose metallic parts are soldered to the nearest points of the revolving coil of wire, W W W, which thus forms the armature, A A.

There being always some residual magnetism in the iron pole-pieces, N S, and iron cores of the armature, A (after having once been magnetized by a battery or other dynamo), a weak magnetic field exists between N and S before starting. The magnetic lines of force pass through the armature, A A, and its iron core at right angles to the copper wires, W W W, coiled round the same; consequently, upon the armature revolving, its copper-wire coil cuts these lines of force at right angles, causing a current to be generated, as previously explained. This current is led off by the brushes in the direction shown by the arrows, still further increasing the magnetism of N and S, which, in turn, reacts on the armature core and coil, until such a speed is attained that the electricity generated and flowing round M M M M, completely saturates its iron cores and pole-pieces with magnetism. Any further increase in speed will cause unnecessary heating of the electro-magnet coils, owing to the current passing through them being in excess of that required to saturate the cores and poles. See MAGNETISM and VOLTAIC ELECTRICITY.

In the limited space at our disposal it is impossible to go into the various modifications of this parent type of dynamo. As a practical example, however, of a successful machine used in this and foreign countries, the annexed cut illustrates the Pilsen-Schuckert Dynamo, which is used for supplying current to arc, semi-incandescent, and incandescent lamps. The same letters of reference as in the typical form (fig 12) have been attached to the various parts, viz. P is the pulley for the driving belt from the engine, flywheel, or intermediate shaft; S, the dynamo spindle carrying the armature A, revolving between the N and S poles of the electro-magnets M M; B_1 B_2 the brushes for collecting the current from the commutator, C; T +, T —, the positive and negative terminals of the machine, which are connected by leading wires to the lamps. One of the advantages of this machine is that the armature can be easily removed for inspection or repair, without disturbing the electro-magnets, and the large radius of the armature permits of the machine being driven at a comparatively low number of revolutions per minute. For arc and semi-incandescent lighting the electro-magnets are joined in series with the armature and the lamps, while for incandescent lighting they are wound with fine wire and joined up as a shunt to the armature, or wound partly with fine wire and partly with the thicker armature and main circuit wire, in what is termed the "compound series and shunt" principle, with a view of maintaining a constant electrical pressure or electro-motive force in the mains, so as to admit of any number of lamps within the powers of the dynamo being turned out or in at pleasure so long as the speed is kept constant. In other words, the dynamo is rendered self-regulating for a variation of load, if the motive power is simultaneously regulated to maintain a constant speed. This latter object it is found impossible to attain except within narrow limits by any ordinary form of engine governor solely depending upon variation in speed; but with an electrical governor such as Jamieson & Alley's, where advantage is taken not only of any tendency to an increase or decrease of speed, but also of any slight variation of current in the electro-magnets of the dynamo by which to regulate the engine, the desired constancy of speed, and consequently of electro-motive force, is easily maintained.

The Leading Wires or Conductors of Electricity.—These should be composed of the very best copper wire well insulated, so as to prevent loss of current from leakage. It is false economy to use small conductors, as energy is thereby lost in heating them, with a possible danger to property; but if the following rule by Sir William Thomson be followed no

such undue waste or danger will accrue—viz. "when the annual cost of power wasted in heating the conductors equals the yearly interest plus depreciation and insurance on their value, then we have the most economical and safe size of leading wire." On the above basis he recommends a size of bare conductor equal to 1 square centimetre per 50 amperes of current. For the highest class of insulated leading wires for use on board ship, where the length of leads is limited and the lights are not kept alight more than half the day, Mr. Jamieson, Principal of the College of Science and Arts, Glasgow, finds that 150 amperes can be carried per square centimetre of section of conductor with perfect safety and economy. The forward and return wires should be carefully separated throughout by at least one inch, with as few joints as possible, and where these are necessary the conductors should be well soldered and insulated.

Arc Lights.—The arc light essentially consists of two carbon rods, kept apart by suitable mechanism at a constant distance when at work, so as to produce a steady light, and admitting of their coming together automatically when the current is stopped, as well as of being cut out of circuit when anything goes wrong with a lamp without affecting the others worked by the same dynamo. The first two conditions are easily attained if there be but one lamp in circuit, and a simple form is shown in fig. 13, where S S represents a solenoid coil of copper wire, No. 10 B.W.G., insulated with cotton and shellac varnish; I C, iron core (hollow); F S, quickly pitched six-threaded screw ($1\frac{3}{4}$ in. pitch); N, nut with lower upturned edge milled; P, pall or lever held down by a bent spring; C H, carbon holders; C + C— carbons 13 millimetres diameter; G R, G R, parallel iron guide rods; B C H, brass crosshead.

In this lamp the current in passing from the dynamo to the upper carbon traverses the solenoid coil, S S, acting inductively on the hollow iron core, I C, and sucking it upwards, thus lifting the upper from the lower carbon by engaging the nut, N, which is fitted to the central screw, F S. The milled edge of the nut comes against the lever pall P, and is thereby prevented from turning round, thus limiting the length of arc. As the arc burns longer the resistance of the circuit increases, the current thereby necessarily diminishes in strength, and the lifting power of the solenoid becomes less, allowing the iron core to drop a minute distance, just sufficient to clear the milled edge of nut, N, from the pall, P; the nut turns round through a degree or so, which allows the carbon to drop a very small distance, the normal length of arc being in this way resumed. The above operation takes place so rapidly that the upper carbon is fed forward in almost perfect unison with the consumption, insuring a steady light.

From tests made of this lamp an actual, not nominal, candle power of 2250 candles, or 1450 candles per horse-power, $\frac{E \times C}{746}$, at the lamp was obtained—the electricity being furnished by an A Gramme dynamo.

An ambiguity which has arisen, and which is very confusing to those not acquainted with electrical phraseology, is the expression so many candles per "electrical horse-power," or so many candles per horse-power expended in the lamp. When this expression is used, it is to be understood that the electrical energy absorbed by the lamp, and developed in the form of heat and light, is according to the formula, $\frac{E \times C}{746}$ (which we stated at the beginning of this article was an actual horse-power of 33,000 foot-pounds per minute). This takes no account whatever of the energy lost in transmission through the leading wires, or that absorbed by the dynamo, or that spent on the moving parts of the engine shafting and belting through friction, &c. It is considered fairly good work, in actual practice, if we get 60 per cent. of the horse-power, as indicated by diagrams taken from the steam cylinder, in the form of electricity, at the lamp carbons or arc. The loss of power in conversion and transmission may be roughly computed as follows:—

	Per Cent.
Loss by friction, &c., in engine, &c., . . .	15
Loss in conversion of mechanical to electrical energy in dynamo, by heating, friction, &c.,	15
Loss by heating leading wires and lamp circuit coils, ...	10
Total loss, ...	40

One has therefore always to be on his guard when inquiring "how much power such and such a lamp or system gives in the form of light;" and it is generally necessary to ask the question, "Do you mean so much cylinder horse-power, or so much dynamical (brake) horse-power, or so much in the form of electrical energy at the lamp?"

Brush Lamp.—Perhaps no lamp has been so extensively adopted as the Brush lamp in workshops and streets. Its popularity and success mainly depend upon the fact that it is arranged so that a large number can be included in series and worked from one dynamo. As many as forty of these lamps have been worked, in numerous instances, by one machine while the whole system is so adjusted by means of an automatic carbon regulator, that one or more of the lamps can be extinguished or removed without endangering the others remaining in circuit. The only danger arising from using such a large number of lamps in circuit, placed in series, is the necessarily high electro-motive force of the current, attended as it is by rapid fluctuations in strength. The normal electro-motive force or difference of potential between the terminals of each lamp being 45 volts, 40 such lamps, *irrespective* of the leading wires and dynamo, require an electrical pressure of 1800 volts, or about 2000 volts including the dynamo and leads; therefore the connections and leading wires should be well insulated, and the handling of the same should be done with care and caution. The normal strength of current is 10 amperes, so that each lamp absorbs energy to the amount of $E \times C = 45 \times 10 = 450$ watts.

By comparing the theoretical diagram (fig. 14), with the following description of details, the principle and action of the lamp will be easily understood. Only one coil and carbon are shown, for simplicity, although there are generally two. T + and T — represent lamp terminals; F C, hollow feed coil with thick copper wire (0·12 ohm resistance) wound round it in a right-hand spiral, terminating at S C, slip contact bearing on carbon holder. Also round F C is wound a thin copper shunt wire (160 ohms) in a left-hand spiral. This fine wire is continued to and wound round C O, cut-out coil (40 ohms), to terminal, T —; I C, iron core, which is sucked up inside F C, under the preponderating influence of the stronger current passing through the thick wire, against gravity and against the effect of the weaker current passing through the fine shunt wire, thus lifting L, lever, which tilts W, washer or clip ring, which in turn lifts C +, upper carbon, from C —, lower carbon, thus forming the arc.

The upper carbon falls towards the lower one periodically, being automatically retarded in its progress by the action of the varying proportions of current passing through the thick and thin wires of the feed coil, F C, due to the varying length and consequent resistance of the arc.

The cut-out coil is also wound with a thick copper wire in the same direction as the fine wire around it, but the thick wire is only brought into circuit on the carbons burning out, or extinguishing of the lamp and breaking the arc through an accident. Should this take place, a greater proportion of current than usual flows through the fine wire, strongly magnetizing the iron core of the cut-out coil, C O,

which attracts the iron keeper K fixed to lever *l*, thus establishing a low-resistance circuit for the main current by way of spring S, lever *l*, contact *k*, through thick wire of C O, to terminal, T−, and thence to the next lamp in the series, effectually cutting the lamp in question out of circuit until repaired. This lamp gives a normal light of 600 candles with a bare arc.

The Pilsen Arc Lamp.—One of the steadiest and most handsome of arc lamps yet invented is the Pilsen, which takes its name from the town in Hungary in which the inventors, Messrs. Piette & Krizik, commenced its manufacture. It is essentially an electrical lamp, the current of electricity directly controlling the carbons, and not, as in most other similar systems of arc lighting, acting upon some clutch or clockwork, which in its turn controls the carbons.

The special and novel feature of this lamp (see fig. 15) is the use and action of a biconical or spindle-shaped iron core when suspended between, and partly through, the interiors of two magnetic solenoids, M, M[1], placed one above the other, through which an electric current is passing. When so used such a core has no positive or balanced position, and can be moved, and will remain in any new position.

The uniform action of this peculiarly-shaped iron core is due to the equal and opposite magnetic effect which appears as the result from the decrease of the mass of iron in one solenoid being compensated for by the increase of its magnetic action, and *vice versâ*, and it is this most interesting feature which constitutes the principal peculiarity in the Pilsen lamp. The normal light furnished by this lamp is about 1000 candles with a bare arc, and it can be worked twelve in series by the Pilsen-Schuckert dynamo, already described.

One great drawback to the introduction of arc lighting has been its proverbial unsteadiness and piercing white rays, but fortunately with the experience gained in its introduction to many of our large railway stations, workshops, and factories these evils have in a great measure been overcome, so that now it is possible to get a perfectly steady pure white light, or one toned to almost any desired shade, by means of suitably ground glass or opalescent globes. Its cost of working is not great, as herewith indicated by the independent statement of Mr. Kirk, M.I.C.E., the managing partner of the well-known firm of Messrs. Robert Napier & Sons, shipbuilders, Glasgow, at a meeting of the Institution of Engineers and Shipbuilders of Scotland:—

Cost of electric light maintenance per week,	£0	1	6
Man's wages, per week, ...	0	15	0
Cost of carbons (forty-nine hours a week),	0	13	9
Depreciation in value of Brush machine, lamps, lights, at 10 per cent.; interest 5 per cent. on £724, ...	2	1	9
Twelve lamps per week, . . .	£3	12	0
Or each lamp per week, . . .	0	6	0

"He had not put in the cost of engine power, because no one could find any appreciable difference in the coal bills for the period before and after the electric light was introduced. The dynamos used by them had been driven by the factory engine, which was quite steady enough for the arc lights. Almost any ordinarily steady engine was sufficient for the purpose. The dynamos had given no trouble except in getting the commutators removed."

Semi-incandescent Lighting.—This form of lighting by electricity is exceedingly simple and steady, although the power required to maintain it, say per 100 candle-power, is considerably in excess of that required for arc lighting pure and simple, although not greater than that for the incandescent system. The semi-incandescent lamp most in favour in this country is the Joel lamp, which consists of a long thin cylindrical rod of carbon, E (fig. 16), kept permanently in contact with a metal block, by means of a counter-weight, C, solenoid, S, and pulley arrangement, R. The current required for this lamp is of low electro-motive force, and any number of lamps may be placed in series within the limits of the dynamo generating the current, while the normal candle-power ranges from sixty to eighty standard candles.

Incandescent Lighting.—When a strong electric current is passed through a conductor of small sectional area of high specific resistance, an intense heat is generated, because the energy of the current is transformed into its equivalent in heat in overcoming or forcing its way through the resistance.

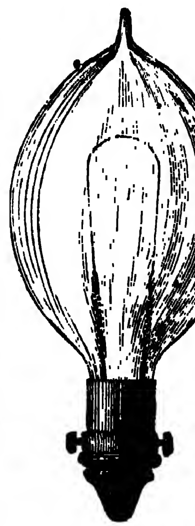
Suppose a number of different conductors, such as silver, copper, iron, platinum, and carbon, all in the form of wire of the same sectional area and length, to be joined up together in one continuous string with a battery or dynamo, and the same current sent through them until the silver reached, say, a temperature of blood heat, we should find the copper uncomfortably warm for the hand to bear, the iron red, the platinum bright red, and the carbon intensely white hot, each in turn more highly heated than the former on account of its being a worse conductor of electricity, the relative conducting powers of these materials being—silver, 100; copper, 80; iron, 14; platinum, 10; carbon, ·04. It would be found, however, that the carbon would almost immediately be burned up, owing to its combining rapidly with the oxygen of the air at such a high temperature; but if it be placed inside a glass globe from which the air has been extracted, it glows with a beautiful white incandescence, without the least sign of being wasted or destroyed. If the current passed through the silver, copper, iron, or platinum wires were increased, so as to bring them respectively to a very high temperature, whether in the air or in a vacuum, they would fuse; but as carbon is practically infusible, it is by far the best of all the known substances for the purposes of incandescent lighting. True, it may be disintegrated by too strong a current, or, in other words, by excessive molecular vibration; but if the current be properly regulated to suit the size of the filament, and if the vacuum remains perfect, there is no scientific reason why a carbon filament in a vacuum should not last for an indefinite time. This fact has been known theoretically for several years, and many experimenters since 1841, such as Moleyne, Starr, King, Staite, Petrie, Konn, and others, made incandescent lamps by heating platinum, iridium, or carbon by electric currents, but they severally failed on account of the difficulty of producing a sufficiently perfect vacuum. In fact, the life of their lamps was short, because their wires or filaments got fused or burned up. The problem was laid aside as a practical impossibility until Professor Crookes, in his experiments on his beautiful radiometer in 1879–80, discovered the means of producing very high vacua by means of a Sprengel air-pump. Almost simultaneously Lane Fox, Swan, Edison, and Maxim, taking advantage of this discovery, devised lamps which all have for their fundamental principle a carbon filament in a vacuum, rendered incandescent by an electric current. Many others since 1882 have made minor improvements in the details, such as Crookes, Gatehouse, Woodhouse, and Rawson, &c., so that now there is no difficulty in obtaining incandescent lamps which will give a light of twenty standard candles, and last on an average 1000 hours.

The Swan lamp (fig. 17) consists of the carbon filament, C F, formed into a loop, with its free ends joined by a kind of Chinese-ink gum to two platinum wires, p_1, p_2, which pass through the ends of the glass globe and finish in two loops or terminals, T + and T −. This filament is formed by taking ordinary cotton crochet thread, immersing it for a few seconds in sulphuric acid and water (two parts sulphuric to one part water), then washing in clean water, and thus parchmentizing it. The parchmentized thread is

then carbonized by placing it in a fire-clay box and heating to a high temperature for several hours in a furnace. The thread is thus rendered as hard and elastic as a steel spring. The object of using platinum as the connecting wires is, that platinum has nearly the same coefficient of expansion as glass. If copper or silver were used, these wires on becoming slightly heated by the current and proximity to the hot carbon would expand and break the glass. After the carbon filament and its platinum connections have been introduced into the globe, the air is carefully extracted by a Sprengel air-pump attached to the opposite end of the glass bulb, and during the later stages of this operation an electric current is sent through the carbon to render it red hot, and thus expel the last traces of air from the molecular spaces before hermetically sealing up the globe by the blowpipe.

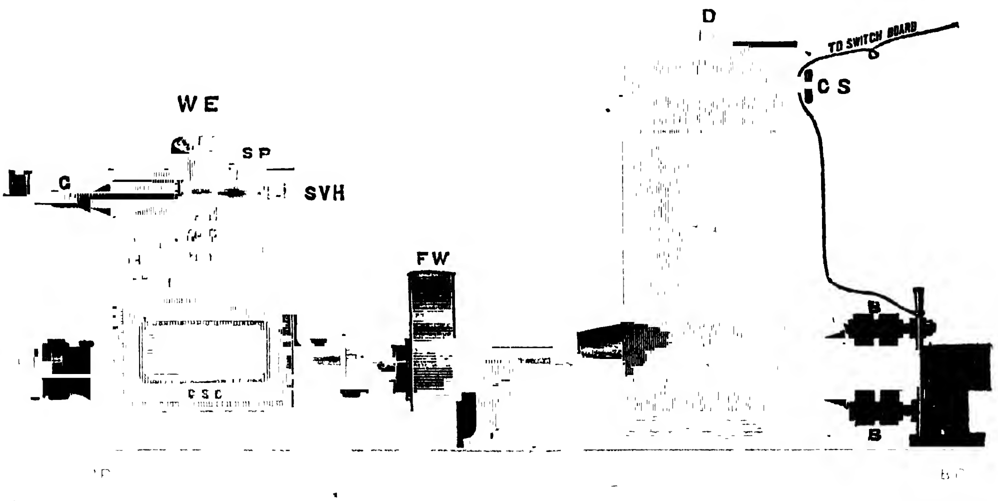
Edison's lamp, with its holder, is shown at fig. 18. Edison uses a filament produced by carbonizing a piece of bamboo fibre pared down and bent into a horse-shoe shape, as shown. The ends of his carbon filament, B, are fixed to the platinum wires which pass through the glass by an electro-deposition of copper, which insures perfect and permanent contact. One of the platinum wires is soldered to a thin metal screw, D, and the other to a central metal button, E, insulated by stucco from the screw. The holder, as shown, has a female screw, which fits the male screw on the lamp, and a contact which bears on the button when the lamp is screwed home. Between these is inserted an ordinary key or contact maker, by means of which the lamp can be turned off or on at pleasure, in the same way and with the same ease as a gas jet.

The Gatehouse incandescent lamp has been brought to great perfection by the Pilsen & Joel Electric Light Co., at their London Malden Factories, as the following tests, which were carefully taken by Sir William Thomson's current and potential galvanometers, show:— Date of test, 28th December, 1883; resistance cold, 78 ohms; resistance hot, 38·4 ohms; E.M.F. 43 volts; current, 1·12 ampere; candles, 20; candles per horse-power, K × 746 ÷ E × C, 310; number of twenty-candle lamps per horse-power, 746 ÷ E × C, 15·5; watts per lamp, 48·2. If these lamps on extended trials can only show as long an existence as others, say 1000 hours, when glowing at twenty candles, then a decided economy in power required to work them has been effected. This means smaller engines, dynamos, and leads for the same candle-power. It is in this direction chiefly that improvements must be sought, for in respect to the best engines, dynamos, and wires there is not so much room left for reducing the loss of energy as there appears to be in raising the light efficiency of the lamps.



Complete Gatehouse Lamp.

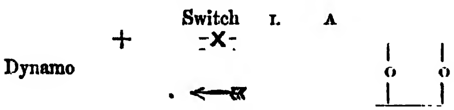
The introduction of incandescent lighting has led to the production of some beautiful forms of brackets and chandeliers, or electroliers as they have been called.



Various forms of these brackets, to suit different conditions and positions, are shown in Plate III., in which fig. 19 represents a Joel lamp as suspended from ceiling, fig. 20 an ornamental standard lamp for the table, fig. 21 an ornamental electrolier for suspension, and figs. 22 and 23 forms of brackets for incandescent lamps.

Incandescent lighting has as yet made more progress in connection with the illumination of our large men-of-war and first-class steamers than in the permanent lighting of houses. At the beginning of this article a promise was made to give an example of the adaptation of electric lighting to steamships. For this purpose the installation on board the very handsome passenger steamer *Adelaide*, built and engined by Messrs. D. & W. Henderson of Glasgow, for the Adelaide Steamship Company, South Australia, will prove suitable. In this vessel there were 130 Edison 16 candle-power lamps dispersed throughout the vessel, and four of 100 candle-power placed near the gangways for facilitating passengers and their luggage being got off and on after dark when in port. The Westinghouse engine, W E, and Edison dynamo, D (see above cut), were fixed on one cast-iron bed-plate, B P, placed on the ship's floors opposite the thrust shaft and near the starting platform of the main engines. The steam pipe, S P, was attached both to the main and the donkey boiler, while the exhaust pipe, E P, was led to the condenser or hot well

of the main engines; the stop-valve handle, S V H, regulated the admission of steam along with the sensitive governor G, driven by a pulley and belt from the crank shaft, S. The cranks and working parts were encased in C S C, the crank-shaft casing, half filled with oil. The fly wheel, F W, assists not only as a means of keeping up a steady motion, but also in starting the engine. The electro-magnets of the dynamo are shown at E M, the armature at A, with the north-pole piece, N, while the armature commutator is seen at A C, the brushes at B B, and the current switch at C S. The lights throughout the ship were joined up in quantities of about twenty for the different departments, saloon, saloon cabins, engine and boiler rooms, &c., each section being controlled by a main switch placed on a large switch board opposite the dynamo, as well as by another in a convenient place near the positions of the lights, while every lamp was fitted also with an independent switch and fusible wire. The lamps were all placed in "multiple arc" thus:—



The system admitted of turning off or on a certain number without endangering the others in circuit.

Such a system of lighting is much appreciated by passengers and ships' officers, and now scarcely a passenger steamer of any importance leaves the shipbuilder's hands without being fitted throughout with the electric light.

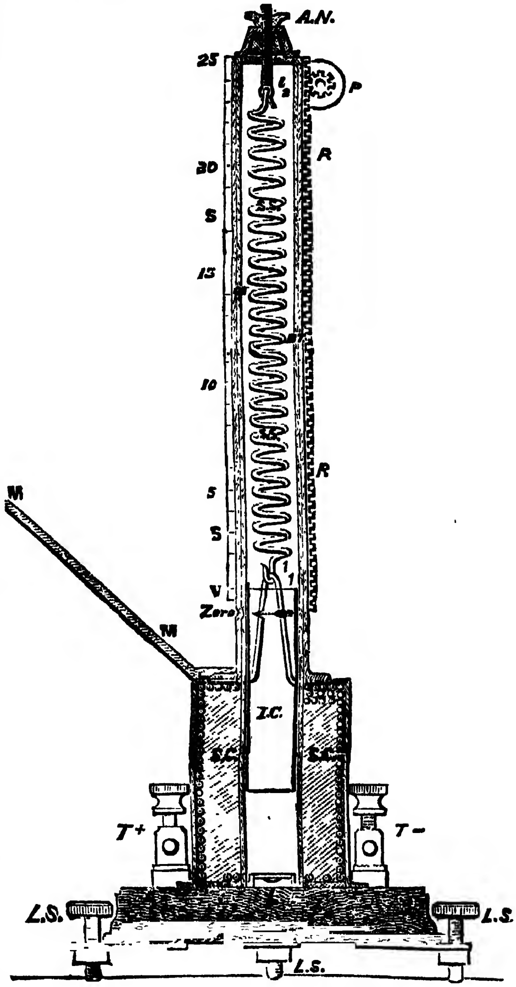
ELECTRIC METERS FOR CURRENTS AND POTENTIALS. The development of electric lighting has necessitated the invention of special instruments for measuring stronger currents and greater electro-motive forces than were demanded by those used for submarine and other telegraphic purposes. Prominent among the inventors of these instruments are Sir William Thomson, Sir William Siemens, and Professors Ayrton and Perry, Mr. Crompton, Mr. Kapp, and Professor Blyth. We select the instruments made to the designs of the latter gentleman, by Messrs. Elliott Brothers of London, not only because they remain constant and are not affected by proximity to dynamos or magnets, but also on account of the accurate workmanship and thoroughly reliable manner in which they are made and graduated.

The following cut is a section of Blyth's current meter, which is graduated by the electrolysis of water.

T + and T — represent the + and — terminals, to which wires from the battery or dynamo are attached; the current passes from T + to T — through S C, the solenoid coil, composed of some three or four turns of insulated copper wire No. 8 B.W.G., and = 0·07 ohm resistance; I C, the iron core, made of best soft iron, in the form of a thin tube. When the current passes, I C is sucked down inside S C, proportionally to the current strength, against the resistance offered by S S, the spiral spring, which is attached to I C by loop l_1, and at top by l_2 to A N, the screw for adjusting the zero of the instrument, as marked on core I C. R and P are the rack and pinion fixed to B T, the brass tube, which slides freely inside an outer brass tube; V is a vernier, fixed to B T, and which by its position indicates on S, a finely-divided scale fixed to the outer | (brass tube), the current strength or number of amperes flowing through the solenoid coil, S C; M, the mirror, by looking down upon which the zero mark on I C (which is to be seen owing to a hole and pointer in the outer brass tube), as well as the position of the vernier on the divided scale, are simultaneously observed and parallax avoided; L, a spirit level; L S, three levelling screws.

How to take a Test with this Instrument.—1. Level it by means of the three screws, L S.

2. Free the core I C by releasing three set screws not shown, and observe if its zero mark agrees with zero pointer on outer brass tube, at the same time that zero of vernier,



Section of Blyth's Current Meter.

V, agrees with the zero of scale. If not, adjust first by A N and second by R and P.

3. Attach leading wires to terminals T + and T —.

4. Switch on current (when the iron or solenoid core, I C, will be sucked down inside S C).

5. Raise I C by R and P until zero mark on I C is again opposite zero pointer on brass tube.

6. Read now the position of vernier, V, on scale S, and refer to the table attached to instrument for the corresponding amperes.

Blyth's potential meter is precisely the same in form as the instrument just described for measuring currents, only the solenoid coil is formed of long fine wire, 5000 to 6000 ohms.

By placing the current meter in direct circuit and the potential meter as a shunt to a lamp, dynamo, or battery, the current (C) in amperes and the electro-motive force (E) in volts are simultaneously found; when by the

formula [see ELECTRIC LIGHTING] $E \times C$ we get the energy in watts, and by $\frac{E \times C}{746}$ the horse-power spent on the lamp or developed by the dynamo or battery. For tangent galvanometers see VOLTAIC ELECTRICITY.

ELECTRIC TELEGRAPH. See TELEGRAPH.

ELECTRI'CITY. This important agent has come into prominence only within comparatively recent times. Even until the seventeenth century its existence was unknown, and although some of its simpler effects had been observed as far back as the time of the Greek philosopher Thales, they were accounted for in the whimsical way characteristic of the ancients in explaining the origin of various natural phenomena. Everywhere throughout nature electricity seems to play an active part; but since human beings are not endowed with a sense by which to directly observe its presence, almost the whole of these manifestations take place outside our knowledge. Were we affected by electricity in a mode analogous to that in which we are affected by light, the entire face of the world and of everything around us would be revealed with a new picturesqueness, and the rapid and ever-recurring changes of electrical condition would present to us appearances which in splendour might reasonably be expected to rival the beautiful effects due to colour and light and shade. The presence of electricity can be detected only in cases where by its action it produces effects to which we are sensible. In lightning and the aurora, the most popularly known of electrical phenomena, it attracts observation in consequence of its producing light and sound (thunder) in the former case, and light alone in the latter, these *effects* being perceptible by us. In its nature it resembles an attribute or state of matter, and not matter itself; therefore a body having electricity has nothing material added to it, and is neither lighter nor heavier than when destitute of electricity. At rest it is called *statical* electricity; in motion, *current*, *voltaic*, or *dynamical* electricity. The present article will be confined to the first of these. For the other department of the subject see ELECTRIC LIGHTING, ELECTRO-CHEMISTRY, THERMO-ELECTRICITY, VOLTAIC ELECTRICITY, &c. The effects due to it when stationary differ widely from those to which it gives origin while moving or *flowing*. In almost every department of the arts electricity renders extensive and invaluable service, the leading instances of its application being telegraphy, telephony, electric-lighting, and electro-metallurgy. The contrivances by which electricity may be generated are of great variety, but all the most useful are modifications of a few types in which friction, statical induction, chemical action, magnetism, or heat is employed.

Frictional Electricity.—In the evolution of electricity by friction, opportunity is readily found for examining step by step the elementary laws of the generation of electricity, and also the different phases of its action; more particularly, however, the laws and action that pertain to electricity in the condition of rest.

Electrification by Friction.—If a tube or rod of glass be approached to within a short distance of a number of light bodies lying loosely upon a table—small fragments of tissue-paper, for example—these will remain unaffected. On substituting an ordinary stick of sealing-wax for the glass, an identical absence of result is observed. But let the same glass after having been smartly rubbed with a piece of silk, or the same sealing-wax rubbed with flannel, be now brought over the pieces of paper. These last will at once spring from the table in considerable number, affixing themselves to the rubbed body (fig. 1 in Plate). The explanation of their change of behaviour is this:—In the first case the paper was unaffected because the rod of glass and the stick of sealing-wax possessed no electricity, or are said to have been *neutral.* The pieces of paper also were neutral. In the second case the process of rubbing had excited electricity upon the surface of the glass, and also of the sealing-wax, and the attraction of the pieces of paper was effected by the electricity residing on the glass and on the sealing-wax respectively. Moreover, the pieces of paper will be attracted in this manner towards *any* body upon the exposed surface of which there exists an appreciable quantity of electricity. Therefore it is seen that friction may produce electricity, and that the attraction of neutral light bodies is evidence of the presence of electricity. Besides paper many other light bodies are equally suitable for this experiment, such as bran, small feathers, or a pith-ball suspended by a thread (fig. 2, P pith-ball, G an electrified glass rod attracting P). Here it may be remarked by the way, that some of the light bodies immediately after the adhesion already described fly back with equal alacrity towards the table, while others do so languidly and after a longer interval, a fact the cause of which will be explained further on.

Action of Electrified Bodies upon each other.—Balance a glass tube which has been rubbed with silk, and on bringing near it the flannel-rubbed sealing-wax, the former will be *attracted* towards the latter (fig. 3, G glass, S sealing-wax). The excited sealing-wax, if pivoted, will move towards the excited glass. But suppose there are two rods of glass, both rubbed with silk, then the balanced glass rod will be driven away when the other is approached to it, an effect called *repulsion* (see fig. 4). Two sticks of sealing-wax rubbed with flannel also *repel* each other. It is usual to explain these and other electrical phenomena by means of a hypothesis, the *two-fluid theory*, now known to be inconsistent, in a literal sense, with physical facts, yet serving well to furnish ideas and terms of great assistance in reasoning. This theory assumes the existence of two peculiar electrical fluids, one named *positive* (or +), the other *negative* (or —). In the previous experiments here given, glass rubbed with silk acquires + electricity, while sealing-wax rubbed with flannel obtains —. The two fluids are said to attract each other, a fact instanced in the attraction between the + glass and the — sealing-wax; but each fluid repels its own kind, as in the repulsion between the two + rods of glass, and also between the two — sticks of sealing-wax. Equal quantities of these fluids when combined disguise each other's presence, thus restoring neutrality; and in a neutral body they are supposed to be co-existent in a state of complete combination, in equal amount, and in infinite quantity, by this means forming what is called a *neutral* fluid. Faraday advanced a new theory, which dispenses with such impossible fluids, and attributes electrical phenomena to a peculiar state of tension or stress in the molecules of bodies. Notwithstanding that this theory is now generally adopted by scientific men, they justify the retention of the old nomenclature on the ground of its convenience.

Both kinds of Electricity are always produced simultaneously and in exactly equal quantities.—Examination of the silk with which the glass was rubbed shows the presence there of — electricity, the amount being equal to that of the + upon the glass. With the sealing-wax and flannel rubbed together the former will be — and the latter + in exactly the same degree. The friction between two bodies decomposes part of the compound neutral fluid into its constituents, + and —, so that the bodies when separated are found electrified on the surface, one with + and the other with — in equal quantity. The particular kind of electricity produced on one body when rubbed by another depends on some relationship between the two not yet understood; but in order that any electricity may be produced upon them they must differ either in structure, chemical constitution, or temperature. Glass when rubbed with certain substances becomes —, and sealing-wax may be made + provided an appropriate rubber is chosen.

Conductors and Non-conductors or Insulators.—Many

bodies, however, when rubbed with a dissimilar substance, do not under ordinary conditions give evidence of the production of electricity upon them. This is conspicuously the case with metals and damp bodies. A rod of brass held in the hand and rubbed with another substance will not attract the pieces of paper in fig. 1, nor give any other sign of electrification. Electricity is indeed generated upon the brass, but at the very moment of its production it at once passes off to the earth through the brass itself, and the hand and body of the operator. Many materials thus allow electricity to pass through them; hence to these the name *conductors* has been applied. On the other hand, as was seen, glass and sealing-wax do not offer this facility to being traversed by electricity, and therefore are named *non-conductors* or *insulators*. Still there is no perfect conductor and no perfect insulator, for even the best conductors present some opposition to the passage of electricity, while the most efficient insulators do conduct, although in each case it may be to only an infinitesimally small extent. Metals, carbon, acids, water, and living animals are conductors of different degree. Examples of insulators or non-conductors are—sealing-wax, glass, solid paraffin, ebonite, gutta-percha, india-rubber, silk, porcelain, air. The degree of non-conduction, called *resistance*, is capable of measurement, there being a standard unit of resistance, the *ohm*. [See ELECTRIC LIGHTING.] In the case of excited insulators the electricity remains at each point of the surface where originally developed. It becomes possible for a conductor to be electrified or *charged* when an insulator has been interposed between the conductor and the hand, because with such a condition there is no complete conducting path to earth. Thus a brass rod *insulated* in this manner retains any electricity it may subsequently acquire. A convenient appliance in electrical experiment is the *insulating stool* or *stand* (fig. 5), consisting of a wooden top insulated from the earth by varnished glass legs. Standing upon this, a person may receive and keep a charge of electricity, thereby being enabled to exhibit in himself all the phenomena incidental to the behaviour of an electrified body. If a weak charge of electricity be actually required to travel from one spot to another there must extend between them a complete conducting path. A powerful charge may, however, be able to force its way through an insulator. Sometimes an insulator *seems* to conduct, and this is frequently observed with glass. Glass being liable to condense upon its surface the moisture of the atmosphere, and water being a conductor, the electricity would thereby have a ready path of escape along the surface of the glass. To avoid this serious defect it is absolutely necessary during the course of an electrical experiment to keep all the glass in use thoroughly warm and dry, and the same precaution should be adopted with every insulator similarly employed. Yet despite all care it is difficult to prevent a charge from gradually becoming lost or dissipated with the lapse of time. If after thoroughly cleansing and heating a glass rod or support it is covered with a thin layer of warm shellac varnish, free from water, its powers of insulation are rendered less liable to be affected by a warm atmosphere.

Distribution.—In the case of a so-called non-conductor the electricity resides for a time at any point at which it may have been excited or placed. This is not true of a conductor. On a conductor the electricity spreads itself over the external surface, remaining on the surface and not penetrating into the mass. With this knowledge it becomes easy to explain the otherwise mysterious tendency of electricity to flow from a conductor to the earth, which is likewise a conductor. The charge cannot usually lea[ve] a conductor supported by an insulator such as the varnished glass support G S in fig. 10, and stand I in fig. 12, or having an insulator between it and the earth, as with the brass rod grasped by the sheet of india-rubber. But in the absence of this insulator, the brass, the human body, and the earth form one complete conductor. Roughly, it may be said that electricity distributes itself among a series of conductors in proportion to their surface; consequently the enormous surface of the earth will receive as its share what is virtually the entire original charge of the rod, the portion of the charge left upon the latter being utterly inappreciable. It is therefore a law that any conductor containing free electricity becomes discharged when a conducting path exists between it and the earth. The mode of distribution of electricity upon a conductor depends greatly upon its form. At all parts of the surface of a sphere, at a distance from other conductors, the density of the charge would be the same (fig. 6, where the dotted line represents the density). But electricity having a self-repelling tendency therefore accumulates at edges, and especially at points. The density on a coin would be greatest at the edge (fig. 7), as indicated by the dotted line *m n o p q*, and at the point of a needle the density is usually so very great as to drive the charge off from the body into the air at the point (fig. 8), as shown by the dotted line *n o p*. This is called discharge by *convection*. The rush of the repelled electrified air from a point may be powerful enough to extinguish a lighted candle, or to cause a star wheel with points to revolve, as in fig. 9. In one important respect the lightning conductor acts on this principle of convection. [See LIGHTNING.] Electricity at rest is not found in hollows or on internal surfaces, unless special expedients are adopted to bring it into such localities.

Induction.—Faraday proved that a charge of electricity always *induces* or generates upon neighbouring conductors an amount of electricity equal to itself, but of opposite kind. To take the positively excited glass rod G as an example (fig. 10), its + would act upon the neutral fluid of an adjacent conductor, C, decomposing it into its constituents, + and —, of which the —, or the kind the opposite of that on the glass, would be attracted to a part near the glass, and held there by that attraction. At the same time the + liberated on the conductor would be repelled to a part distant from the glass; and further, were the conductor connected with earth by some suitable means (fig. 11), this repelled + would be discharged to earth. One vital point to be observed here is that the attracted — is held on the conductor by the action of the + glass even when the path to earth exists; but with the removal of the glass the retaining influence would also be removed, and simultaneously thereupon the —, no longer held, would be instantly discharged to earth. In fig. 1 each light body when attracted is in the electrical condition of the conductor in fig. 11. Those of them which were referred to as leaving the glass immediately after contact were repelled by the glass in consequence of the — charge upon them being neutralized and replaced by + from the glass. Those which do not leave so readily remain in consequence of their charges not being at once neutralized and changed. The respective amount of electricity induced upon each of a number of surrounding conductors depends upon distance and form in each case, and also upon the medium, named the *dielectric*, across which the inductive action takes place. In figs. 10 and 11 air is the *dielectric;* in a Leyden jar, glass; in a submarine cable, the gutta-percha or india-rubber covering. A large conductor placed very near a charged body will be found to have almost the whole of the induced charge upon it, a condition of which the Leyden jar furnishes a notable example.

The Frictional Machine.—The amount of electricity produced on a rubbed rod of glass or sealing-wax is small; consequently to produce a considerable quantity, more elaborate contrivances are employed, the frictional machine (fig. 12) being the commonest of these. It consists essentially of a glass *cylinder*, A B (in section, fig. 13), rotated in the direction of the arrow. Against one side of the cylinder there presses a *rubber*, R (shown separately, fig. 14),

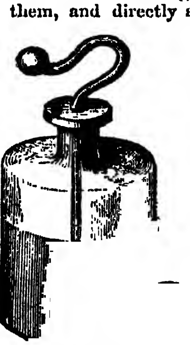
and on the other side is the brass *comb* with metal teeth, T (see fig. 15), the points of which are directed towards the glass. T is connected metallically with the brass cylinder H, the *prime conductor* as it is called. On turning A B the rubber R receives — electricity, and the glass + (see fig. 18). The + surface at length arriving opposite the comb T decomposes the neutral electricity of the combined conductor H and T, attracting — to the points and repelling + to H. By convection the — on the points streams across the air to the glass, and unites with the + there, so that the glass passes on neutral. By this action H is gradually acquiring more and more +, as the electrified part of the cylinder continues to be neutralized by the discharge from T. R must be connected to earth by a conductor, K, to allow its — to escape, or the arrangement will work badly. If R be kept insulated by its glass support, and H *put to earth*, — electricity will accumulate upon R, while the + upon H will go to earth. There are many other forms of the frictional machine, those most in favour having a glass or ebonite disc instead of a glass cylinder, as in fig. 16.

Induction Machines.—In these machines, by means of a minute initial charge, a large quantity of electricity can ultimately be obtained. The simplest is the *electrophorus* (fig. 17). A metallic base or sole, D, has placed upon it a cake of some resinous compound, B, the surface of which becomes electrified—by being struck with a piece of flannel or cat's skin. On the cake is laid a metal disc, A, to be held by an insulating handle. The — cake acts inductively upon the disc, attracting + and repelling —, the latter proceeding to earth when A is touched by the finger. On now raising A by the glass handle, it is found charged with the attracted + (fig. 18). After the charge thus obtained has been utilized, A may be again charged in the same way as at first, and yet again and again, as often as may be wished, these successive charges being all obtained from the one excitation of B. Nevertheless it is to be remembered that whatever the manner in which electricity is procured, there must be an amount of energy expended equivalent to the electricity obtained. The replenisher invented by Varley, and used in Sir William Thomson's quadrant electrometer, acts upon the same principle of induction. [See VOLTAIC ELECTRICITY.] But the most striking of all machines of this type is that invented by Holtz, capable of sending an electric spark across 10 inches of air, or even a much greater distance. It employs the principle of convection as well as that of induction (fig. 19).

Instruments for Testing Electricity.—To detect the presence of electricity or to determine its kind, whether + or —, the electroscope is used (fig. 20). Its principal parts are a disc D, from which extends downwards a brass rod R, two gold leaves L_1 L_2 being attached to the lower end of the latter, as shown. R passes through a shellac tube or stopper fixed in the neck of a glass flask. The shellac serves to insulate the parts already described, and the flask to protect the leaves from disturbance by currents of air. When the leaves are electrified similarly, as always happens when they are electrified at all, they repel each other and appear divergent. An electrified body brought near D (fig. 21), causes the leaves to diverge with the repelled induced charge, while the attracted charge is accumulated on D. If the body being tested be neutral the leaves will remain together. In using this instrument to ascertain the kind of electricity upon a body, a charge of known kind must first be given to the disc and leaves by contact or by induction, say + (fig. 22). On the approach towards the disc of the body to be tested, the leaves may diverge further or they may fall together. The former result occurs when the electricity on the disc is repelled to the leaves by the examined charge (fig. 23), which is thus proved to be of the same kind as that in the electroscope. In the latter result, the electricity has been withdrawn from the leaves to the disc (fig. 24), thus indicating that the charge being tested is opposite in kind to that in the electroscope. This collapse of the leaves might be brought about by a neutral body, and on that account is not conclusive. On such an indication being given the electroscope should be recharged with electricity of opposite sign to that previously possessed by it, and the test repeated. If collapse again takes place, the body must be neutral; but increased divergence will prove the identity of the charge of the body with that in the electroscope. For more delicate work the electrometer of Sir William Thomson is required, by which it is possible not only to detect extremely weak charges of electricity and their sign, but also to give to electrical potential or pressure a numerical value according to an established system of which the unit is the *volt*.

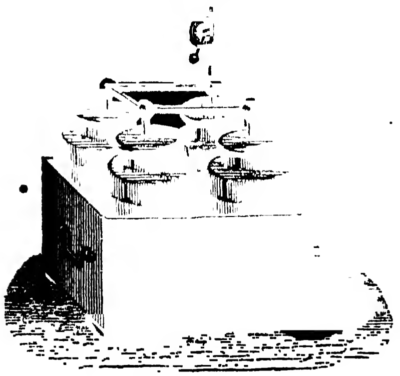
Accumulation of Electricity.—When the density of electricity upon an exposed surface is great, part of the charge is rapidly dissipated into the air. But by employing the *condenser* a comparatively large quantity of electricity can be lodged upon a small surface with considerably diminished liability to this loss. Two sheets of tinfoil of the same size are fixed one on each side of a sheet of glass (fig. 25), the edges of the tinfoil being fully an inch within the edge of the glass. One sheet of tinfoil, T_1 T_1, is connected with a source of + electricity, P C, and the other, T_2 T_2, with earth. The + electricity, as it is produced on P C, tends to accumulate on that face of T_1 T_1 next the glass, there being great facility offered for inductive action upon T_2 T_2, which is near, and also forms a portion of that immense conductor, the earth. Thus acted upon, T_2 T_2 acquires — on the side adjacent to T_1 T_1, and the repelled + escapes to earth.

Owing to the highly insulating property of the glass between these two opposing charges, they are unable to combine by spark or otherwise. But should the glass be thin they may succeed in sparking through it, thus making a hole in the glass, and rendering it useless as an insulator in this experiment. Or in the event of the sheets of tinfoil extending too near the edge of the glass, a spark may pass round the edge. This is the simplest arrangement of the condenser. The quantity of electricity it is capable of accumulating depends upon its *capacity*, which varies directly as the area of one of the coatings, inversely as the distance between them, and directly as the specific inductive capacity of the dielectric. Another arrangement, more efficient, but differing in no way in principle from the form first described, is the *Leyden Jar*. The glass, shaped like a jar, has one sheet of tinfoil pasted to its inner surface and the other sheet to its outer surface. Extending from the interior, through a wooden stopper intended to keep out dust and moisture, is a brass rod, to the inside end of which is attached a chain lying on the inner tinfoil, and to the exterior end a spherical knob. To charge the jar the outer coating is held by the hand, or otherwise put to earth, while the knob is at the same time placed very near to or against the source of electricity, which then accumulates in the jar. To discharge the jar the two coatings should be joined by a conductor. It generally happens, however, that before this junction is quite completed the charges combine across the small interval of air between the conductor and either of the coatings. If, while the outer coating is to earth, the knob of the inner coating be touched by the hand, a complete conducting path between the coatings will



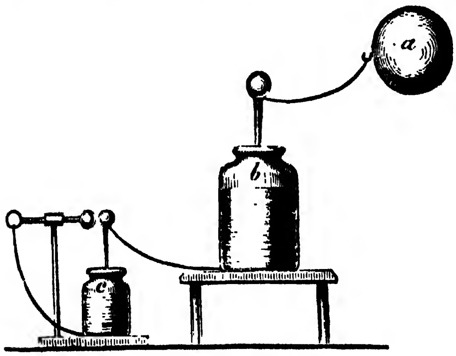
Leyden Jar.

then be provided, and a shock will be experienced, sometimes disagreeable and possibly dangerous, caused by the union of the electricities through the body. If the spark pass through a vacuum in a glass vessel, the appearance will resemble that of the aurora. This *disruptive* discharge will be further adverted to under LIGHTNING. By connecting together the knobs of a number of jars



Leyden Battery.

by a conductor, the capacity of the whole is the sum of the capacity of all the jars, so that by this means a powerful charge can be accumulated. The external coating of each jar must of course be in connection with earth. This arrangement is called a Leyden Battery (see cut). Jars in *cascade* arrangement are also shown. Here all



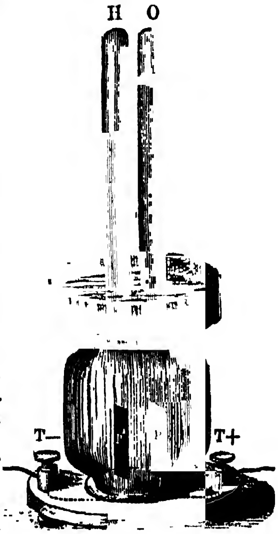
Charge by Cascade.

the jars are insulated from earth except the last; and from the outer coating of one jar to the knob of the succeeding one a wire is extended. The inner coating of the first jar, *b*, communicates with the prime conductor, *a*, of an electrical machine by a chain. The repelled charge from the outer coating of each jar becomes the charge on the inner coating of the following jar, as at *c*.

ELECTRO-CHEMISTRY may be divided into two branches, *Electrolysis*, or the decomposition of certain liquids by an electric current, and *Electro-metallurgy*, the art of depositing electro-chemically certain metals from a solution containing them.

ELECTROLYSIS.—No substance can be decomposed so long as it is in a solid or gaseous state; it must first be brought to a liquid condition, either by solution or fusion, before the current can act on it. A compound substance capable of decomposition by a current is called an electrolyte (that is, unbound by the aid of electricity). The poles or plates by which the current enters and leaves the electrolyte are called electrodes or electric ways, the positive (+) pole having the anode (from the Greek words *ana*, up; and *hodos*, a way), and the negative (—) pole the cathode (from *cata*, down, and *hodos*). The constituents into which the electrolyte is decomposed are called ions (from *ion*, going); the electro-positive substances, or those going to the cathode, are called *cations;* and the electro-negative substances, which go to the anode, are called *anions.* The *electro-chemical* equivalent of an ion is the quantity set free by the passage of a unit quantity of electricity.

The decomposition of water by an electric current is generally taken as the best visible means of illustrating electrolysis. The annexed cut represents a convenient form of apparatus, where T + and T — are the positive and negative terminals of a voltaic battery, P and P^2 platinum plates attached to T + and T — by platinum wires hermetically sealed into the glass through which they pass. Tubes H and O are first filled with acidulated water, and whenever a current of sufficient strength is allowed to flow from the battery, hydrogen, H, is seen to be disengaged at the negative (—) plate, while oxygen, O, is liberated at the positive (+) one; and further, as the decomposition proceeds, twice as much hydrogen is liberated as oxygen, water being composed of two parts of hydrogen to one part of oxygen, or H_2O.



Polarization.—Whenever an electrolyte is decomposed by a current of electricity, the resolved ions have a tendency to reunite, thus setting up an opposing electromotive force to the decomposing current. This tendency to reunite is commonly termed "chemical affinity." The electro-motive force of the decomposing current must therefore be greater than that due to the chemical affinity of the resolved ions. For example, when water is decomposed by a current of electricity into its constituent ions, oxygen and hydrogen, the opposing electromotive force due to the chemical affinity of these two gases is about 1·5 volt; therefore, to decompose water, the battery should have an electro-motive force greater than 1·5 volt. (See Munro & Jamieson's "Electrical Pocket Book" for the way to calculate the opposing electro-motive force set up in decomposing any electrolyte.)

Quantitative Laws of Electrolysis.—I. The amount of chemical action is equal at all points of a circuit.

II. The quantity of an ion liberated at an electrode in a given time is proportional to the strength of the current in amperes.

III. The quantity of an ion liberated at an electrode in one second is equal to the strength of the current multiplied by the "electro-chemical equivalent" of the ion.

The above rules apply not only to the decomposition in a depositing bath, or outside the battery, but also to that taking place inside the charging battery itself.

One ampere decomposes ·0000945 gramme of water per second, liberating ·0000105 gramme of hydrogen and ·0000840 gramme of oxygen.

The amount in grammes of any other ion liberated from

an electrolyte in one second by a current of one ampere is given by the electro-chemical equivalent of the ion. The electro-chemical equivalent of any element is found by multiplying its chemical equivalent (or atomic weight ÷ valency) by the equivalent for hydrogen—viz., ·0000105.

If C = current in amperes, T = the time in seconds } $CT = Q$ — quantity in coulombs,
z = the electro-chemical equivalent,
w = the weight in grammes of the ion (or element) liberated; then

$$w = CTz = Qz.$$

Weight of Metal deposited from a solution of any of its salts by a current of C amperes in T seconds is

$$w = CTz = \cdot 0000105\ CaT,$$

where a is the chemical equivalent of the metal.

Example.—A current of ·5 ampere passes through a solution of cyanide of silver for ten minutes; weight of silver deposited—

$$w = \cdot 5 \times 10' \times 60'' \times \cdot 0011340 = \cdot 0000105 \times \cdot 5 \times 108 \times 10 \times 60 = \cdot 3402 \text{ gramme.}$$

ELECTRO-METALLURGY has two departments, which are distinguished by the preparation of the surfaces to be coated.

Electro-plating is the production of adhesive deposits, and depends on the absolute cleanness of the metal-surface coated.

Electro-typing is the production of removable deposits from either non-metallic moulds, rendered conductors by blackleading or by silvering, or from metal-surfaces, whose cleanness is destroyed either by blackleading or by rubbing with turpentine containing a trace of wax. The preparation of the objects depends (1) upon the class of deposit required; (2) upon the nature of the object itself. In all cases ordinary dirt, rust, &c., must be removed, as the deposit reproduces every feature of the surface, even to a finger mark.

Copper, brass, zinc, and the noble metals are cleaned by the suitable acids which act on them. Such cleaning solutions may be prepared for different metals as follows, recommended by J. T. Sprague:—

	Water.	Nitric.	Sulphuric.	Hydro-chloric.
For copper and brass,	100	50	100	2
Iron,	100	2	8	2
" (cast),	100	3	12	3
Zinc,	100	—	10	—
Silver,	100	10	—	—

It is best to make two such solutions; one being reserved for a final dip, during which a strong action occurs upon the surface. As this becomes weaker it can be used for the first cleansing, accompanied by occasional rubbing with sand, &c., according to the nature of the object.

Lead, tin, and pewter must not be placed in acid, but are cleaned by aid of caustic soda.

Objects must be carefully freed from acids if they are to be transferred to silver or gold solutions, but less care is necessary for objects cleaned in soda, nor is the same care necessary in transferring objects cleaned in acids to an acid-coppering solution. In such cases the best plan is to dip into clean water, and at once transfer to the depositing cell.

The solutions used to deposit from must be adapted to the object to be deposited upon, and must have no action or but very little upon it, though cyanide of silver and gold have some chemical action upon copper and brass, which should be resisted by connecting the object to the electric circuit before immersion.

Suitable solutions can generally be made by passing a current from a plate of the required metal into a solution of the solvent, though it is better to prepare them chemically. Thus copper does not dissolve in dilute sulphuric acid, but it will dissolve and make a good working solution if the current is passed through a plate of copper. Silver solution may be thus prepared by using anodes of silver in a solution of 6 oz. of cyanide of potassium to the gallon of water. For gold the best solution is the cyanide of gold in cyanide of potassium. It may be advantageously prepared by the current process, because of the risk of loss of metal in precipitation, but the chemical process gives the best result; using chloride of gold in place of nitrate of silver, the process is exactly the same as for silver solution. This solution is worked hot, at about 150° Fahr., and the result depends upon proper management of the heat and current strength, and the articles should be kept in constant motion. The colour changes very rapidly, and the process can be mastered only by practice. A solution for depositing iron can be made in like manner with one part of sal-ammoniac in ten of water; so also may a nickel solution, but the best solution (the double sulphate) cannot be so made, because it is insoluble in excess of sulphate of ammonia. To prepare solutions in this manner large anodes should be used, and small cathodes, which should be contained in a porous cell; the operation is complete when a deposit begins to form on the cathode. The best solution for copper is a saturated solution of sulphate of copper, mixed with one-quarter of water containing one-tenth its volume of oil of vitriol.

Iron and steel are usually coated first with a film of copper, as silver will not adhere to them.

Adhesion of the plating is rendered more perfect by amalgamating the objects before silvering and gilding; this is effected by dipping them in a solution of 1 oz. of nitrate of mercury in a gallon of water, which is well brushed over the object.

Platinum is deposited from several solutions, of which the best is the precipitate formed by soda or ammonia in platinic chloride dissolved in oxalic or citric acid.

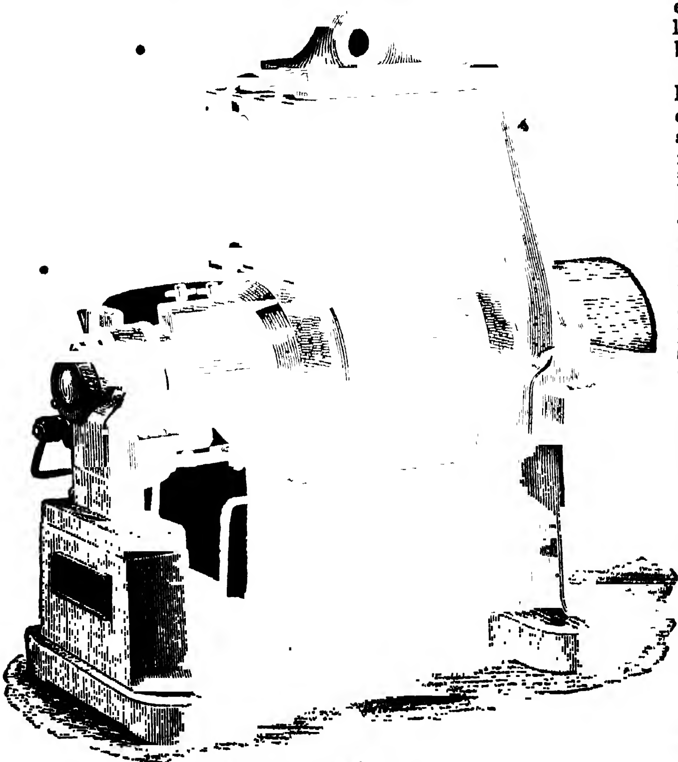
The metal deposited is always porous, and will not protect the metal beneath it against the action of acids.

Until within the last few years large batteries, such as Smee's and Daniell's, were used both for electro-plating and electro-typing, but now that dynamo-electric machines are made with such perfection they are being fast introduced.

The advantages of dynamos over batteries are (1), they are cheaper to work; (2), they are always ready for work; (3), where steam-power is already on the premises the cost of running them is scarcely appreciable, and they require very little attention; (4), they take up less room than a quantity of cells; (5), they are much cleaner and easier handled than batteries; (6), any desired current may at once be obtained, or any number of baths may be worked in series by simply driving the dynamo faster or slower as required.

One of the most successful dynamos for electro-plating and electro-typing purposes is that shown in the cut on following page, made by Messrs. Siemens Brothers, London. It is suitable for producing heavy deposits of copper, and is that known as their C_6C machine. It works through up to four cells, arranged in series, and deposits in each cell 7 oz. of copper per hour, requiring only 1½ horse-power to drive it; it is driven at from 400 to 900 revolutions per minute, according as one, two, three, or four baths are worked by it in series. In the case of heavy electro-typing, where it is advisable not to stop the dynamo during night, a small gas engine will be found useful after the machinery of large works is stopped, or the introduction into the circuit of a few voltaic cells, so as to prevent layers being formed. Dynamos of very small dimensions, for silver

and nickel electro-plating and gilding, as well as large dynamos for the electro-deposition and refinement of copper upon a huge scale, either from crude copper or from a



Dynamo for Electro-deposition.

solution, are now being worked with marked success. In America Mr. Mackay, the Californian millionaire, uses a steam engine of several hundred horse-power driving an immense dynamo for depositing copper on steel wire to form aerial line telegraph wires—the steel heart giving the required strength, and the copper coating the desired conductivity for long lines.

In actual practice if the current is taken from a dynamo the depositing cells are arranged in series, so that the E.M.F. would require to be for four cells at least,

$$4 \times \cdot 836 = 3\cdot 344 \text{ volts,}$$

and the current in the circuit to deposit 1 lb. of copper per hour in the whole four cells (or $\frac{1}{4}$ lb. per cell) would be $\frac{381\cdot 1}{3\cdot 344} = 114$ amperes. Also, so much power is spent in friction of bearings, heating of dynamo, &c., that it has been proved from trial with a Siemens' C_6C dynamo run at 900 revolutions per minute, using four depositing cells in series, that it takes ·85 indicated horse-power to deposit 1 lb. of copper per hour, or one horse-power deposits 1·1 lb. of copper per hour. Larger machines are more effective, for a Siemens' C_1 will deposit about 5 cwt. in twenty-four hours for 115 indicated horse-power, or say, 2 lbs. of copper per horse-power per hour, or ·5 horse-power per pound of copper deposited per hour, which is very economical. In the deposition of copper for the ordinary electrotyping of printing matter, 4 square feet go to the pound of copper, so that for every horse-power hour 64 square feet of strongly deposited copper can be secured by means of a good dynamo and a well-regulated depositing bath.

ELEC'TUARY, a term applied to a compound of various medicines, united by means of syrup or wine, and formed into a soft mass nearly of the consistence of honey. Substances in the state of powder or extract thus combined may be swallowed without their natural taste being perceived.

EL'EGY (from Gr. *elegos*), in English, commonly means a short poem composed on some person's death; also, in a more general sense, any mournful or serious poem, as for instance, Gray's "Elegy in a Country Churchyard." The Greek word *élegos* was originally a strain of lament; *elegeion*, the form of versification in which such strains were first composed by the Greeks, that is, the combination of an hexameter and a pentameter (commonly called long and short) verse; *elegeia*, a poem made up of such verses. The elegiac was the first variation from the hexametral or epic measure, and the change of form corresponded with a change of subject; the poet in epic composition keeping himself and the workings of his own mind out of sight, while, on the contrary, the free and full expression of the poet's feelings, as affected by external circumstances, constituted the essence of the Greek elegy. Hence arises its variety; the poets soon abandoned the original subject of the verse, and attacked with their new weapon every kind of loftier emotion and thought. The elegiacs of Callinus and Tyrtæus (the earliest) were political and warlike; of Mimnermus, contemplative and melancholy; of Theognis and Solon, moral and political. The elegiac was also a favourite metre for epigrams. See EPIGRAM.

ELEMENTS, in chemistry, those substances which have never been resolved into two or more simpler kinds of matter. There are at present known about sixty-four elements, but the number is increased from time to time by fresh discoveries. We annex a list of the elements, with the *symbol* by which each is denoted by chemists, and the *atomic weight*. See ATOMIC THEORY.

Name of Element.	Symbol.	Atomic Weight.	Name of Element.	Symbol.	Atomic Weight.
Aluminium,	Al	27·11	Iridium,	Ir	197.0
Antimony,	Sb	119·9	Iron,	Fe	56·02
Arsenicum,	As	75·09	Lanthanum,	La	92·0
Barium,	Ba	137·2	Lead,	Pb	206·9
Bismuth,	Bi	208·0	Lithium,	L	7·02
Boron,	B	10·9	Magnesium,	Mg	24 0
Bromine,	Br	79·95	Manganese,	Mn	54·9
Cadmium,	Cd	112·0	Mercury,	Hg	200·3
Cæsium,	Cs	133·0	Molybdenum,	Mo	96·0
Calcium,	Ca	40·02	Nickel,	Ni	58·7
Carbon,	C	12·003	Niobium,	Nb	94·0
Cerium,	Ce	92·0	Nitrogen,	N	14·046
Chlorine,	Cl	35·45	Osmium,	Os	199·0
Chromium,	Cr	52·5	Oxygen,	O	16·0
Cobalt,	Co	58·7	Palladium,	Pd	106·0
Copper,	Cu	63·34	Phosphorus,	P	31·04
Didymium,	D	96·0	Platinum,	Pt	194·8
Erbium,	E	112·0	Potassium,	K	39·14
Fluorine,	F	19·1	Rhodium,	Ro	104·0
Glucinum,	G	9·5	Rubidium,	Rb	85·0
Gallium,	Ga	—	Ruthenium,	Ru	104·0
Gold,	Au	196·6	Selenium,	Se	79·5
Hydrogen,	H	1·002	Silicon,	Si	28·0
Indium,	In	113·4	Silver,	Ag	107·93
Iodine,	I	126·85	Sodium,	Na	23·05

Name of Element.	Symbol.	Atomic Weight.	Name of Element.	Symbol.	Atomic Weight.
Strontium, . . .	Sr	87·5	Titanium, . . .	Ti	50·0
Sulphur, ...	S	32·06	Tungsten, . . .	W	184·0
Tantalum, . . .	Ta	182·0	Uranium, . . .	U	120·0
Tellurium, . . .	Te	129·0	Vanadium, . . .	V	51·0
Thallium, . . .	Tl	204·0	Yttrium, ...	Y	59·7
Thorinum, . . .	Th	115·7	Zinc, ...	Zn	65·0
Tin, ...	Sn	117·6	Zirconium, . . .	Zr	89·0

EL'EMI. See CANARIUM.

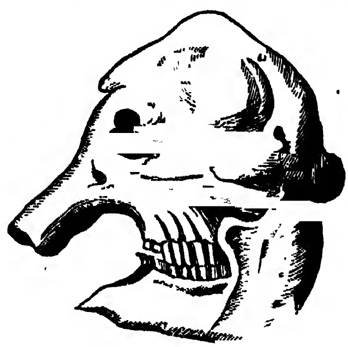
ELEN'CHUS, the Latin form of the Greek *elenchos*, commonly translated by the words *argumentum*, *inquisitio*, *confutatio*, and *demonstratio*, is of frequent use in the Aristotelian logic, and signifies argument, replication, refutation, or the point, subject, or nature of dispute or demonstration. The sophism designated *Ignoratio elenchi*, that is, a real ignorance of, or sinister deviation from, the point under discussion, consists in proving something irrelevant, and which, as it may be true without affecting the truth of the real proposition, does not determine the question. Aristotle includes under this designation the introduction of anything extraneous to the point in dispute; the disproving of what is not asserted, as well as the proving of what is not denied. In all cases of irrelevant conclusion, when something is proved which does not in reality contradict the adversary's proposition, the latent fallacy is best exposed by showing that both propositions may be equally true.

EL'EPHANT (Elephas) is a genus of Mammalia forming with the extinct genera MASTODON and DINOTHERIUM the order PROBOSCIDEA (proboscis-bearing animals), allied in many respects to the Ungulata, but highly specialized in some characters, as the proboscis, skull, and teeth. Of this genus only two species are extant—one peculiar to India, Ceylon, Cochin-China, Siam, Pegu, Ava, and the larger islands of the Indian Archipelago, *Elephas indicus;* the other is a native of Africa south of the Sahara, *Elephas africanus*. The elephant of Ceylon and Sumatra is considered by some a third species, called *Elephas sumatranus*. It is, however, now generally considered that the minor differences of structure that divide the elephant of Ceylon from that of India do not admit of specific distinction, and that there are in reality only the two species above mentioned. Before adverting more particularly to them, a few observations, necessarily brief, on the more remarkable structural peculiarities common to both may be admissible.

Skull.—The skull of the elephant appears to be enor-

Skull of Indian Elephant.

mously capacious, and the forehead nobly developed; but this is all deceptive. The two tables of the bones forming the anterior part of the skull are separated from each other by a wide interval, which is divided into numerous cells, the whole occupying an immense space, behind and below which is the cerebral cavity, which compared with the magnitude of the cranium is small; hence it is that a ball striking the centre of the elephant's forehead will either pass over the



Skull of African Elephant.

cerebral cavity or lodge in the maze of cells without causing the animal to drop.

The Proboscis or Trunk.—The enormous size of the tusks (incisor teeth), their position, and the development of the alveoli necessary for their reception, and which advance before, and as it were hang over the mouth, render it necessary that some expedient be adopted in order to enable the elephant to obtain its food; and this the more so as the vast weight of the head and tusks is necessarily combined with such a shortness of neck, that it appears as if the head were fixed to the front of the body without the intervention of a decided neck. The limbs, like thick columns, are organs alone of support and locomotion. They cannot be used as are the paws of the squirrel. The elephant cannot browse on the leaves of trees or bushes, as do the rhinoceros and hippopotamus; for the tusks and their alveoli prevent the application of the mouth, and, what is more, shorten the nasal bones so that the nasal apertures of the skull above the alveoli seem as if pierced in the forehead. An upper lip of the common form, as in the horse or the rhinoceros, is out of the question. The proboscis is therefore a *special* organ with many functions, being at once a delicate organ of prehension, a strenuous grasper, an arm of offence, and a pump for the suction of water. By its means the elephant feeds itself and slakes its thirst, or throws a shower-bath over its own body or over that of some unfortunate offender.

The proboscis or trunk of the elephant may be regarded as a muscular prolongation of the nostrils, into which the upper lip also is blended. This proboscis is of a tapering subconical form and has internally two perforations. On the upper side of the extremity, immediately

End of Elephant's Trunk (profile).

above the partition of the nostrils, is an elongated process, which may be considered as a finger; and on the under edge is a sort of tubercle which acts as an opposable point, in short, as a thumb. Composed of thousands of muscles variously interlaced, this organ possesses the most complicated powers of mobility, of extension, and of contraction, and is besides endowed with exquisite sensibility. The length of this organ, from 6 to 8 feet, according to the height of the individual, supplies the place of a long neck; and by its means the elephant not only gathers its food and feeds itself, but also supplies itself with drink. Sucking up the water till the two cavities of the proboscis are filled, the animal curves it round, inserts the extremity into its mouth, and drives the water into its capacious throat.

The young elephant, however, be it observed, sucks in the usual way—the teats of the female being placed between the two fore legs.

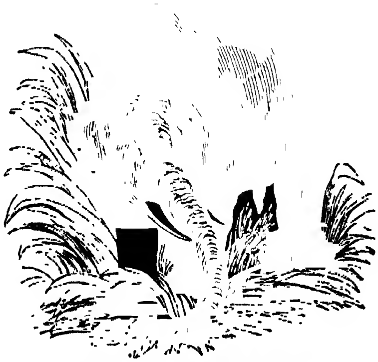
Dentition.—The teeth consist only of molars, and incisors called tusks; there are no incisors in the lower jaw. The molar teeth are composed of ribands of osseous substance cased in enamel, and imbedded in a mass of cement, cortical substance, or *crusta petrosa*. These ribands, which are distinctly seen on the crown of the molars, are transverse, and pass from side to side. A single grinder may, in fact, be regarded as made up of a number of distinct teeth consolidated into one mass. The molars of the elephant when perfect are not permanent, but are shed in due succession for six or eight times, perhaps oftener; and this not from the rising up of a fresh tooth below the one it is to succeed, but by the rising up of a new one behind the old one, and which, gradually becoming developed, advances forwards as the old one wears away, till its last remnant is pushed out. Hence more than one molar tooth and the anterior portion of another (on each side) are never to be seen through the gum of the elephant; as the latter develops, the former diminishes by attrition and absorption. Each succeeding tooth is larger than its predecessor. As the laminæ of the new tooth are successively perfected they advance, and become worn long before the old ones are ready to fall, so that an elephant's molar tooth is never seen in a perfect state—for if it be not worn anteriorly, the posterior part is not formed, and the fangs are wanting; nor is the structure of the back part of the tooth perfected till the anterior portion is gone.

The tusks or upper incisors of the elephant are destitute of true roots, and have no other union to their deep sockets than that of close contact; they resemble a nail driven into a plank, and by gentle and continued pressure may have their direction altered. They consist of concentric layers of ivory, and grow by the continued deposition of these layers added internally; for the pulp or core, which deposits the ivory, fills the cavity at the base of the tusk, and arises from the bottom of the socket. It is of great size, and has no organic union with the tusk it secretes. Bullets are sometimes found embedded in the ivory. In these instances the bullet has entered the socket and lodged in the bottom of the hollow base of the tusk, and the pulp or core in that hollow has kept covering it with layer after layer of ivory, the tusks advancing in due proportion, till at last, from being in the hollow, the bullet attains the solid centre of the tusk, being moved further and further forwards by each deposit of ivory within its hollow base.

The tusks are not shed as the molars, but a permanent pair succeed a deciduous pair shed between the first and second years of existence. The tusks vary in size and curve. In the African species they are generally very large, sometimes even in the female; but in the female of the Asiatic species they are small, and in Ceylon they are generally absent in both sexes. They grow to a very great size, weighing in some cases as much as 200 lbs. Darwin considers the feeble development of the tusks in the females as evidence that they were acquired by the males through sexual selection as weapons for fighting with other males.

Skeleton.—In the Asiatic elephant the skull is more elevated and pyramidal than in the African, and the front is concave. In both the nasal bones are rudimentary; the lachrymal bones are entirely wanting. The spinous processes of the dorsal vertebræ are extremely long and stout for the attachment of the suspensory ligament of the head (*ligamentum nuchæ*). The number of dorsal vertebræ varies in the different species from nineteen to twenty-one. The bones of the limbs bear almost perpendicularly on each other, and the thigh-bone is destitute of the round ligament. Clavicles are altogether absent. The hind limbs are smaller than the fore pair. The limbs are very massive, and the upper segment of the limb is of great length, so that the knee is placed nearer the ground than in most animals; from this circumstance arose the popular belief that the elephant either had no joints in his legs or that they bent in a contrary direction to that of other quadrupeds. The toes are five on each foot, complete in the skeleton, but so buried in the coarse skin of the limb in the living animal that the horn-clad tips alone are visible, and these not always, for in the Asiatic species four nails only appear on the hind feet, and in the African species only three.

Senses.—The elephant possesses the senses of sight, hearing, taste, and smell in great perfection; and its proboscis is an organ of touch and an instrument of prehension.



Asiatic Elephant (*Elephas indicus*).

The eye is small, but quick and lively; the tongue is smooth and pointed.

The external appearance of the elephant is so well known that it is unnecessary to dwell on it. The colossal body is covered with a thick skin, almost entirely hairless in the existing species. The maximum height of both species is about 11 feet.

Habits and Utility to Man.—In a state of nature the elephant lives in herds under the conduct of adult males.

African Elephant (*Elephas africanus*).

They feed on herbage, maize, twigs, and roots, and often commit serious depredations. From time immemorial the art of capturing wild elephants and training them to serve man has been practised, and is still continued in India. Formerly elephants were employed as engines of war, and turrets bearing armed men were fastened on their backs; they were taught the executioner's dreadful trade; they

were adorned with trappings, and paraded to swell the state of princes; they bore the Oriental sportsman in the great hunting matches; they were educated as combatants in the arena, being matched against each other and against the tiger; and they were trained as beasts of burden. The Romans not only slaughtered those animals in the games of the circus, but taught them to dance and perform antics, in order to amuse a rude multitude. In our days an elephant often delights a British audience by its unwieldy performance on the boards of the theatre. At all times the ivory of the elephant has been in request, and is still an important article of commerce. In Africa the flesh of the elephant is relished by many tribes. The ancient Romans considered the trunk as delicious, and Le Vaillant speaks of the foot as a dish for a king.

It was of the African elephant that Pyrrhus and afterwards the Carthaginians anciently availed themselves as an arm of war; and this was the species which Hannibal carried into Italy, and with which the Romans first became practically acquainted. The first elephants seen in Rome were four captured from Pyrrhus at Beneventum, B.C. 276. The Carthaginians at the time of the war in Sicily had stalls for 300 war elephants at Carthage alone, B.C. 255; and Hasdrubal led 140 into the field against the Romans. Hannibal, in 220, took thirty-seven with him on his march from Spain to Italy. The elephants exhibited in the Roman arena by Cæsar and Pompey were African. Julius Cæsar is said to have brought an elephant to Britain B.C. 54, but doubt is thrown upon the statement. Of perfect authenticity, however, are the war elephants used by the Emperor Claudius against the British chief Caractacus in A.D. 43, clad in mail and bearing on their backs turrets filled with slingers and bowmen. At the present time elephants are used in war only in Asia, and even there their use is almost abandoned.

The so-called "white" elephants are not pale varieties of the Indian elephant, but are merely affected with a peculiar condition of the skin. True albinos are sometimes met with, the whole of the body being of a pinkish colour. A "white" elephant was brought to England in 1884 and was deposited in the Gardens of the Zoological Society *en route* for America, having been purchased by an enterprising American showman. This elephant, though scarcely deserving the epithet "white," was in several respects quite unlike any of its kind before seen in England. The general colour of the body was as dark, or darker, than that of other elephants, being of a bluish-slaty hue. There were, however, certain patches where the pigment or colouring matter was absent, the skin being of a pale reddish-brown colour. These patches were disposed symmetrically on both sides of the face, descending to the chest and trunk, with smaller patches behind the ears and on the outer sides of the limbs. Professor Flower, after examining the animal, decided that the peculiar marking was due to a local deficiency of the epidermic pigment, and not to any skin disease. Such peculiarities of colour, together with some other characteristics, as the possession of hazel eyes, and five nails on each foot, entitle the elephant who unites them in his person to considerable respect in Burma and Siam. The kings of both these countries claim, as one of their titles, the designation "Lord of the White Elephant."

The distinctions between the Indian and African elephant may be summed up as follows:—

Elephas indicus.—Head elevated and pyramidal, front concave, molars presenting on their surface transverse, parallel, wavy ribands of enamel; ears small or moderate, pendent; nails on the hind feet, four; tail tufted, with a brush of bristles on each side at the tip.

Elephas africanus.—Top of the head low and rounded, front rather convex; ears of immense volume, triangular, extending over the shoulder, and hanging with the tips below the throat; molar teeth with the bands of enamel forming lozenges on the surface, touching each other along the centre of the tooth; nails on the hind feet, three.

These differences are considered by some naturalists sufficient to justify the separation of the African species as the type of a distinct genus, Loxodon. The gulf, however, between the two existing species is bridged in many ways by fossil elephants, and the proposed separation is seen to be quite unjustifiable.

Fossil Species.—The third and fourth divisions of the Tertiary fresh-water deposits abound in extinct species of recent genera, and among them are the remains of fossil elephants of more than one species. The alluvium, the crag, the ossiferous caverns, the osseous breccias, and the subapennine formations afford the most numerous examples. Fossil bones of the elephant are common in our island and in various parts of Europe, Asia, and America. Teeth and tusks abound in Russia and Siberia and the arctic marshes; the latter in so high a state of preservation that they constitute an article of commerce; indeed, Siberian ivory forms the principal material on which the Russian ivory-turner works.

Of these fossil elephants the most interesting is the MAMMOTH (*Elephas primigenius*), which closely resembled the Indian species, but was clothed with a thick woolly fleece. It ranged over the northern regions of both hemispheres. *Elephas antiquus* and *Elephas meridionalis* were distributed throughout Europe in Pliocene times, occurring in Britain, which at that time was not separated by the sea from the rest of Europe.

ELEPHANT SHREW is the name given to the species of the family Macroscelididæ, which are terrestrial INSECTIVORA, distinguished by the great length of the metatarsal bones and the possession of a long proboscis-like snout, having nostrils at its apex. The hind limbs are longer than the fore pair, and in consequence in their mode of progression they somewhat resemble kangaroos, proceeding by a series of leaps. The typical genus, Macroscelides, contains nearly all the members of this family. The Common Elephant Shrew (*Macroscelides typicus*) inhabits the open country in the interior of South Africa, where it is found inhabiting open arid plains, particularly such as bear a thin coating of brushwood. It lives in burrows under ground, the passage to which is usually for some distance below the surface almost perpendicular; it vacates these during a great portion of the day, and is employed either in seeking its food, which consists of insects, or in basking in the sun's rays.

The elephant shrew is brown above, brightened by an intermixture of tawny, the under surface being whitish; the extremities are covered with a very short whitish hair. The ears are large and round; the tail is long, and thinly clothed with a stiff, short, black hair; there are long whiskers near the base of the proboscis, each hair variegated black and white; the claws are short, black, compressed, and pointed. The length of the body from nostrils to root of tail is $4\frac{3}{4}$ inches; that of the tail, $3\frac{1}{2}$ inches. The colour of both sexes is nearly alike. The dentition is as follows on each side:—Incisors, $\frac{3}{3}$; canines, $\frac{1}{1}$; premolars, $\frac{3}{3}$; molars, $\frac{3}{3}$; a fourth small molar is sometimes present in the lower jaw.

Besides several other South African species, one has been found in Algeria and Barbary. Another species (*Macroscelides tetradactylus*), often made the type of a new genus, Petrodromus, has only four toes on its hind feet. It lives among hills and rocks on the Mozambique coast. In the genus Rhynchocyon are placed four closely allied species from East Africa, differing considerably both in structure and habits from Macroscelides. All the feet have only four toes, and the outer toe is reduced in size. There is only one small incisor on each side of the upper jaw, and these fall out after maturity. The two bones of

the forearm are separate. All the species are nocturnal in their habits.

ELEPHAN'TA, or **SHAPOREE,** is a small island about 7 miles in circumference, situated between the island of Bombay and the Marhatta shore. The name Elephanta was given to the island by the Portuguese, from the figure of an elephant cut out of the solid black rock on the acclivity of a hill about 250 yards from the landing-place, and which is a conspicuous object in approaching the island. The elephant is about three times as large as life, rudely sculptured, and very much dilapidated by the weather. An animal on the back of the elephant has been conjectured to be a tiger, but has no longer any distinguishable shape. The island contains also a large temple-cave, which is about half-way up the steep ascent of the mountain or rock out of which it is excavated. The length of this temple, measuring from the entrance, is 130 feet, and its breadth 123 feet; the floor not being level the height varies from 15 to 17½ feet. The roof is supported by twenty-six pillars and eight pilasters, disposed in four rows. Along the sides of the temple are cut between forty and fifty colossal figures, varying from 12 to 15 feet high; none of them are entirely detached from the wall. The statues are designed with great spirit, and the execution has much beauty and elegance. Facing the main entrance is an enormous bust with three faces, reaching from the pavement to the ceiling, which has been conjectured to be the Trimurti or Hindu Trinity, Brama, Vishnu, and Siva; but Bishop Heber was of opinion that it is Siva only, who is sometimes represented with three faces. The pillars and figures have been much broken and worn away by the weather, and the process of decay is still going on. Nothing is known as to the time when the cave was excavated, nor whether it ever had an establishment of priests. Bishop Heber conjectures it to be a temple to Siva, and that the sculptures have been made within a period more recent than might be imagined from their dilapidated state.

ELEPHANTI'ASIS, the name given to a disease which is endemic in India, China, Arabia, Egypt, the West Indies, and some parts of America, but which occurs very rarely, if ever, in cold or temperate climates. It is characterized by fever, which is of a recurrent character, inflammation of the skin and areolar tissue, followed by an enormous thickening of the skin of some part of the trunk or limbs, notably of the legs and genital organs. The integument forms into hard masses and folds, having a rough surface, causing the affected limb to resemble the leg of an elephant, whence the name of the disease. The causes of this complaint are somewhat obscure, but certain conditions of soil and climate seem to be necessary for its production, and though no race is exempt from the disease the white races are much less subject to it than the dark.

In some forms of the disease its onset is signalized by high fever, intense pain, and strong inflammation, while in others there is but little pain or disturbance of the general health. It has little influence as a rule in shortening life, but when a limb is affected the muscles undergo atrophy and degeneration, and it becomes useless, and when the scrotum is implicated the tumour often becomes of enormous size. Though it may seem incredible, it is a fact that such tumours have been found, which after removal by a surgical operation have weighed over 100 lbs.

In the cure of this disease but little has yet been done by the adoption of constitutional treatment, but when in its earliest stages the disease has often been checked by the removal of the patient to a different climate and surroundings. The application of tight wet bandages to the affected limb has also been tried with success, and many cases have been permanently cured by proper surgical treatment.

The term elephantiasis has also been used to designate the disease of leprosy, and the latter is still sometimes referred to as Elephantiasis Græcorum. For an account of this see LEPROSY.

ELEPHAN'TOPUS, a genus of plants belonging to the order COMPOSITÆ and the tribe Vernoniaceæ. *Elephantopus scaber* grows in dry elevated positions, and is found throughout tropical Asia, Australia, and America. It has a stem a foot high, with the heads of pale red flowers on long stalks. The roots are fibrous. Both the roots and the leaves are reputed to have active medicinal properties. The natives on the Malabar coast use a decoction of them in cases of dysuria. Besides this cosmopolitan species, there is one a native of Senegambia, while the remaining eight or ten are found in tropical America.

In this genus the flowers are all similar and tubular, from two to five form a head, and a number of heads are collected into a head-like cluster; the corolla is cleft on one side, and the pappus bristles are generally chaff-like.

ELEPHANT'S FOOT is the common name for *Testudinaria elephantipes* [see DIOSCOREACEÆ], and is also applied to ELEPHANTOPUS.

ELETTA'RIA. See CARDAMOMS.

ELEUSIN'IAN MYSTERIES. It says much for the sanctity of a solemn oath that so few men have divulged the harmless secrets of the Freemasons, but the Eleusinian mysteries offer a more striking example still. Existent from the earliest times down to the suppression of paganism by the Emperor Theodosius, not a single traitor betrays their hidden ceremonies; and search as we may, and unceasingly do, they remain to us a profound enigma still.

The myth of DEMETER is elsewhere told; and in her wandering and lamentation she came to the little village of Eleusis in Attica, knowing the secret of her daughter's residence in the under-world, but unable to rescue her thence. She abstained from the divine ambrosia, and lived on mortal food; and of that took so little that her emaciated form was not recognizable as that of a great goddess. Sitting by the well at Eleusis under the olive-tree, ever after held sacred, she was found by the daughters of Keleos, fetching water in their brass ewers, and gained employment in their family as a nurse. In gratitude she prepared her baby charge for eternal youth and immortality by nightly plunging him into fire—had not his mother played the spy. Discovered, the goddess ceased her task, commanded a temple to be built and Eumolpus to be the priest; in fact the great family of the Eumolpidæ always retained this honour. To Eumolpus she dictated the multifarious six days' worship, and enjoined secrecy. The Homeric Demeter's hymn, to us so delightful a myth, was to the Athenians the purest truth; the well, the stream, the tree, the temple, they knew them all. A maid servant, Iambô by name, had cheered the sorrowing bereaved mother-goddess by her merry quips and pranks; ever after on returning from the mysteries to Athens, the bridge over Cephissus found its pseudo-Iambé joking and girding at her (or his) fellow pilgrims, and not sparing the great ones of the state. Demeter lived on barley-water with mint, and this peculiar brewage was part of the sacred food of the mystics.

In February each year at Agræ on the Ilissus, outside Athens, were held the lesser mysteries. These were in honour of Persephone, and preparatory to the greater mysteries. The *Mystæ*, or Mystics, thus partly initiated, went in the September of the following year to Eleusis for the latter. These evidently enacted the Demeter-idyll in considerable detail, each day bearing its part. Banquets of special food all relating to the corn-goddess, day processions bearing pomegranates, night processions wandering with torches searching for the lost goddess-child, &c., filled up the six days appropriately, and gratified the crowds who assembled. Then all but the mystics were dismissed by the mystagogue or hierophant; the second oath of secrecy, more stringent than that sworn at the Ilissus, was laid

upon the aspirants, and all were led in perfect darkness into the temple. Here we are told awful ceremonies were performed and wonderful secrets revealed—the mystics, now *epoptæ* or initiated, being dismissed with the inexplicable sacred words κόγξ, ὄμπαξ, as their several turns were over in the long initiation. Then on the seventh day all returned to Athens. An eighth day, in honour of Asclepius, who was said to have arrived too late and to have been specially initiated, accommodated those detained on their road, and a ninth was devoted to final public ceremonies and the jokes at the Cephissus.

As said above we know nothing regarding the sacred rites or doctrines. A few guarded allusions here and there have been held to warrant the assumption that a high monotheism (probably borrowed from the secret priests'-mysteries in Egypt) was revealed; and it seems a very fair inference from the general myth and from these scattered and dim remarks of the ancients, that the comfortable doctrine of the immortality of the soul there cheered the sorrows of bereaved pagan relatives. Those who have given the most attention to this obscure subject think the mysteries likely to be older than the Homeric and Hesiodic theogony; older, simpler, and purer; a faith enriched with lofty Greek and Egyptian speculation, based on the simple love of nature, rejoicing in the everlasting types of the buried and yet after-sprouting seed, of the gladness of spring coming ever after the icy hardness of the killing winter.

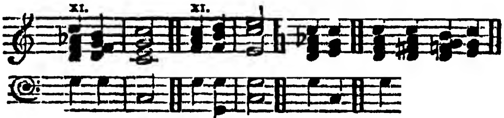
ELEVATION, or UPHEAVAL, is the term used to denote such movements in the earth's crust as cause either the emergence of dry land from the sea, or an increase in the average height of already existing land above the sea-level. Elevation sometimes takes place with great rapidity when caused by earthquakes or volcanic eruptions. In 1822 an earthquake raised a large portion of the Chilian coast 3 or 4 feet above its former height. In 1811 an island arose in the Azores from 20 fathoms water; similar cases have been recorded in other disturbed districts. But cases of sudden elevation, such as those just mentioned, are of very rare occurrence; and the process, in other instances, is exceedingly slow. Occasionally elevation goes on at a sufficiently rapid rate for its results to come under man's observation. Thus, from the records of the Dutch expedition to Novaia Zemlia in 1594, we find that the sea bottom along part of its coast must have risen about 100 feet between that period and the present time. An island found in 1760 near Cape Sviatoi was observed to be joined to the mainland sixty years afterwards. Some islands at Spitzbergen have become joined to the mainland within the last 200 years. But the chief evidences of elevation are of an indirect character. Such are the existence of the shells of shellfish, or the marks and borings produced by them, at some distance above the sea-level, and in sufficient abundance to preclude the idea of their being stray instances thrown up by a storm. Cases of this kind occur on the Scandinavian coast. The pillars of a temple of Jupiter Serapis, in the Bay of Naples, exhibit shellfish borings 20 feet above the present level of the Mediterranean, proving a submergence and subsequent elevation of at least that amount. When the shells of mollusca which are known to live below the low-water mark are discovered at or about the high-water mark, it is clear that elevation must have taken place; evidence of this nature is afforded by the shells of *Pholas dactylus* on the Ayrshire coast, and of *Mya truncata* on that of the Frith of Forth. Again, elevation is proved by the existence of sea-worn caves above the sea-level, and also by "raised beaches," that is, high flat terraces above the sea-level, but which, from their being composed of sand, broken shells, &c., have evidently been at some time part of a sea-shore. Such raised beaches are found in many parts of our own coasts, some of them being as much as 100 feet above the sea. Cases are recorded on the Chilian coast where they are at present over 1000 feet above the sea-level. The existence of marine organisms in any rock is proof that that rock was once beneath the sea-level, and hence discovery of shells at the summits of mountains in the Alps and even loftier chains shows the enormous extent to which elevation has taken place during past times. Indirect proofs of elevation during the human period are afforded by the discovery of human remains in South American raised beaches, and by the fact that piers and harbours are sometimes found some height above the present high-water mark.

The question has been raised as to whether elevation is caused by a fall in the level of the sea arising from its alteration in bulk or form, or by an absolute upheaval of parts of the solid portion of the earth's crust. The majority of geologists adhere to the latter view. This upheaval, where not manifestly volcanic, is generally supposed to be due to the shrinkage and crumpling of the earth's crust consequent on its cooling. But no explanation has been afforded of sufficient force to compel the general assent of geologists.

ELEVATION OF THE HOST (Lat. *hostia*, sacrifice, *i.e.* of the LAMB), one of the most important parts of the Roman Catholic ceremonial of the mass. The priest after having consecrated the sacred elements, and thereby (according to the doctrine of transubstantiation) changed them into very God, holds them high above his head that all in the church may see and kneel and adore. At the same moment a small bell gives notice of the act to those in the street or near by, that they too may join in the devotions of the congregation.

ELEVEN. For some properties of this number see DIVISIBILITY OF NUMBERS.

ELEVENTH. In music an Eleventh is an interval of seventeen semitones, that is, of an Octave above a Fourth; as from c' to f''. As regards the interval and in harmonizing the usual rule is followed, and an Eleventh or an Eighteenth is held to represent a Fourth, and is so treated. But in the theoretical view of DISCORDS the Eleventh and the chord of the Eleventh are of great importance. This chord is only taken on the dominant. It needs no preparation, being a fundamental discord. It is composed of the chord of the dominant Ninth (with either a major or minor Ninth) and a perfect Eleventh added above it. The Eleventh usually remains while the rest of the chord resolves; or else it resolves by itself, or with the Ninth if that is present, while the rest of the chord remains.



Resolutions of the Dominant Eleventh.

ELF, ELF'IN. The elf or beneficent dwarf, very tiny in figure, beautiful and good at heart, is a favourite character in Norse mythology. The elves live in "elfheim," under their king, the elf king or erl king (*erl könig*); and thence at night they troop out, dancing by moonlight in the meadows, swinging round hand in hand in rings, whose marks are seen next morning by the darkened grass, or hovering round the sleepers whom they love, and filling their brains with happy dreams and fancies.

As the word elves had sometimes a less pleasant signification, "black elves" being another name for the familiar dwarfs of Norse legend, we have somewhat unhappily adopted the French "fairy" as a synonym for elf (elf of light), and have too often relegated "elf" to mean only the tricky, mischievous, possibly ugly, elf of darkness. The French *fée* was our elf (of light), *féerie* was the "elfry," the home of elves or fées ("elfheim"); this we took as

the name of the realm of the king of faëry, or queen of faëry, whence our "faëry queen;" and from that adjective to the usual meaning of "fairy" as a noun was but a step.

Returning to elves in the proper sense of the word, as "elves of light," we find them beautiful fair-haired beings, endowed with large magical powers, watching chiefly over the growth of plants, some on land, some in water; loving men and helping them, marrying them sometimes, but fond of playing them tricks in a light-hearted way; dressed always splendidly, with much gold and jewels. Those who, as "bonny Kilmeny" did, sought them out at their revels, were drawn within the charmed ring, and never returned more to their kinsfolk, or if return they did it was but to waste away, to pine and die within the year. In fact, it was rarely good, though so alluring, to have commerce with the elves; man's nature and elf's were too dissimilar, and those who wore elfin armour or magic rings and jewels, though they profited by them for long, yet in the end generally proved less happy than the mere mortals.

Elf is akin to *alp*, and just as alp means both mountain pasture and mountain, so elf serves for spirit of the meadows and spirit of the gloomy bowels of the mountain. As has been said, the latter sense (though "black-elf" would be the proper word) now threatens to employ the word wholly. "Elf-arrows" are, we now know, the flints of prehistoric man, but they were set down as the work of tricksy malicious black-elves shooting at the cattle to bewitch them; "elf-fire" is a popular name for what elsewhere entices men to their death, as the "will o' the wisp" (*ignis fatuus*); children are said to be "elf-marked," and the blotches are held to portend a mischievous character.

Nearer to the old meaning is the expression by which we describe the unkempt tresses of an old witch, or the tumbled tangled masses of a frolicsome girl's hair, as "elf-locks." When maids arose from sleep with hair all in elf-locks, both the tangle and the restless tossing of the head which caused it were set down to a visit from Mab the faëry queen. Mercutio ("Romeo and Juliet") says—

> "This is that very Mab
> That plaits the manes of horses in the night,
> And bakes the elf-locks in foul sluttish hairs."

ELF-ARROWS, the popular name for the flint arrow-heads which were made by the ancient Britons; they are frequently found in England and Scotland. They resemble in appearance the arrow-heads which are still in use among the Esquimaux, and which were used until a very recent period by some tribes of North American Indians. In former times it was believed that they were made by the elves or fairies, and shot from the air by these creatures against horses and cattle, and sometimes against men, and this belief may still be found in some of the secluded districts of Ireland. These arrow-heads were also often worn as charms against witchcraft, and water in which they had been steeped was supposed to possess considerable medicinal value.

EL'GIN, formerly called *Moray* or *Murray*, a county of Scotland, is bounded N. by the Moray Frith, W. by Nairnshire, E. and S.E. by Banffshire, and S. by Inverness-shire. The greatest length, from N. to S., is about 35 miles; the breadth varies from 8 to 15 and 23 miles. Elgin gained slightly in 1870 by an exchange of some small districts with Inverness, by which both counties were rendered more compact. The area is 312,379 square acres. The population in 1881 was 43,788. Elginshire and Nairnshire conjointly return one member to the House of Commons.

The line of sea-coast measures about 30 miles, and presents in some parts precipitous rocks, in others a beach of level sands. The low country forms a plain varying from 5 to 12 miles in width from the sea-shore to the mountainous district, and extending from the river Spey to the western boundary. It is intersected by small ridges running nearly parallel with the line of coast. On the southern course of the Spey are some considerable plains. The rest of the county is hilly.

The rivers are the Spey, the Lossie, and the Findhorn, which flow in a north-east and nearly parallel course to the sea. The Spey has its source in the south-west part of Inverness-shire, and with its branches it discharges into the sea a greater quantity of water than the Thames. The Findhorn rises also in Inverness-shire, and passes through Elginshire near the western boundary. The Lossie is formed by the confluence of numerous streams in the centre of the shire; it passes to the north of the town of Elgin, and falls into the sea on the eastern side of Loch Spynie. There is a good deal of salmon fishing in the Spey and the Findhorn. To the west of the estuary of the Findhorn are some curious shifting sandhills, with an average height of 118 feet. The county contains several lakes, of which one has been drained for cultivation.

A large proportion of Elgin is covered with forests and plantations, chiefly of Scotch fir and larch. The rocks in the south consist of granite, felspar, mica, sandstone, slate, gravel, and rock crystal. The banks of the Spey towards its mouth exhibit secondary rocks of red sandstone, which dip into the basin of the Moray Frith, and extend westward throughout the northern plain of the county. Numerous large granitic boulder stones, which are used for building, are found far from their parent rocks. Many large and inexhaustible quarries of freestone are worked, especially near the coast. One or two quarries of slate supply the county with roofing materials. Neither coal nor any metallic ores of importance are found. Peat is dug in various places.

The soil of the lowland district is remarkably fertile, and is especially adapted for the growth of wheat, oats, and barley, of which it produces many heavy and luxuriant crops, a great portion of which is shipped for the Scotch and English markets. The climate of this part of the county is noted for its general mildness, dryness, and salubrity, owing, it is thought, to the low level of the surface and to the absorbent sandy nature of the soil. The soil and climate of the southern highlands are less favourable for the cultivation of grain, and a great portion of the surface is still covered with native forests, or with uninclosed commons of furze and broom. Oats and barley were formerly the only kinds of grain produced; wheat, though now one of the staple articles of commerce, is of comparatively recent introduction, and still more recent is the cultivation of pease, beans, clover, grasses, turnips, and potatoes; yet the turnip husbandry is very extensively and successfully adopted, and potatoes are common. In the year 1884 there were 105,100 acres under cultivation in the county. The Cheviot breed of sheep has been extensively introduced to cross the native breed. The breed of native cattle has been improved by importations from Skye, Aberdeen, and Argyle.

The people of this county highly appreciate the advantages of early instruction. Even before the passing of the Scotch Education Act a well-conducted parochial school existed in every parish, and it was a rare occurrence to meet with a youth of either sex, however humble, who was not able to read and write.

The chief articles of export from the county are corn, timber, whisky, and salmon. Ships are built at the Spey mouth of fir grown on the banks of the river, which is very durable. The timber trade is one of the most flourishing in the county. The salmon sent from Elgin to London has sometimes amounted in value to £100,000 in one year.

The ancient province of Moray was much more extensive than the present county; it extended from the Spey on the east to the Beauly on the west, and from the sea to the Grampians on the south. There are many antiquarian remains in the county, comprising Druidical temples, Danish fortifications, and mediæval castles and

churches. Among the principal are—King Sueno's Stone; the remains of Forres Castle, supposed to have been a royal residence of Duncan, and afterwards of Macbeth; the Priory of Pluscarden; the Castle of Loughnadurb; the ancient palace of the bishops of Moray; and the church at Birnie, one of the oldest places of worship in Scotland. There are also many fine baronial mansions in the county still inhabited.

ELGIN, the county town of the above shire, and a royal, parliamentary, and municipal burgh, situated on the Lossie, 178 miles from Edinburgh by rail and 584 miles from London by the Highland and Great North of Scotland Railways. The small river Lossie has a winding course on the western and northern sides, and is crossed by one iron bridge and three stone bridges. The beauty of the district around has gained for Elgin the title of the "Garden of Scotland." The town consists of one main street, extending nearly a mile, and numerous narrow lanes, which intersect the main street at right angles and contain houses of ancient construction. Elgin, at the end of the tenth century, was an important place with a royal fort. The earliest charter was granted by Alexander II., in 1234. At a remote era the neighbourhood was adorned with ecclesiastical establishments of monks and friars. One of the most interesting and magnificent ruins in Scotland is the Cathedral of Elgin, which was founded in the year 1244. In 1390 the Earl of Buchan, known as the Wolf of Badenoch, who was a natural son of Robert II., burnt it down together with a considerable part of the town, in revenge for a sentence of excommunication passed upon him. It was immediately rebuilt in a style similar to that of the Cathedral of Lichfield, but on a scale of greater magnitude, and with more elaborate ornaments. The Regent Morton, in 1568, having stripped off the lead of the roof to procure money for the payment of his troops, this venerable specimen of architecture and sculpture was left to decay. In 1711 the great central tower fell to the ground; but the two western turrets, the walls of the choir, and part of the nave and transept are still standing. The loftiness of the fabric, the symmetry and unity of design, and the great profusion of sculpture, must excite admiration for the skill and perseverance of the artists. A college was attached to the cathedral, and included within its walls the house and gardens of the bishop and those of twenty-two canons. Part of the wall, which had four gateways, and was 900 yards in circuit and 12 feet in height, yet remains. On the south side of the town are the ruins of a convent of Gray Friars, and on a hill at the west are the remains of an ancient fort. Another curious relic of the past until recently existed here, in the shape of a pond, known as the "Order Pot" (probably meaning the "Ordeal Pot"), which was the last, or almost the last, representative in Scotland of the ponds where witches were ducked and thieves drowned. The Elgin Institution, for the support of aged persons and the education of youth, is a handsome quadrangular building, surmounted at the eastern entrance with a circular tower and a dome. The building, playgrounds, and shrubbery cover an area of about 3 acres. The objects of this charity are threefold—an almshouse for the aged and indigent, a school for the support and education of labourers' children, and a free-school solely for education. The parish church, in the centre of the town, is one of the most elegant in the north of Scotland. It has a richly ornamented cupola and a Doric portico. Grey's Hospital is a similar structure, with a Grecian portico and a central dome. The places of public worship are numerous, and include an Episcopal and a Roman Catholic chapel The Elgin Academy consists of three parochial schools of very superior character, and there are also some smaller schools. There are several endowed charities, and other religious and benevolent institutions.

The population of the burgh in 1881 was 7267. Elgin, in conjunction with Banff, Cullen, Inverury, Kintore, and Peterhead, sends one member to Parliament. The population of the parliamentary district is 31,804, and the number of electors 3800.

ELGIN, LORD. THOMAS BRUCE, seventh Earl of Elgin, the distinguished collector of the Elgin Marbles, was born in 1771, and educated at Harrow and Westminster schools, and afterwards at the University of St. Andrews. In 1799 he was constituted ambassador-extraordinary and minister-plenipotentiary to the Ottoman Porte. It was while in this position that he was enabled to rescue the remains of Grecian art from destruction and oblivion, and thus to transmit his name to posterity as the noblest patron of art in modern times. Through the assistance of Signor Lusieri and other distinguished artists he was enabled, during the summer of 1800, to form, from Athens and other places in Greece, a complete collection of architectural measurements, delineations of sculpture, plans of existing monuments, statues, bas-reliefs, &c., of the best periods of Athenian art. He also made a valuable collection of Greek medals, inscriptions, and various specimens of the ancient Greek alphabets. But the most important was the inestimable collection of Grecian sculptures, afterwards sold to the English government for £35,000, and deposited in the British Museum, and which, in honour of his lordship, received the appellation of the "ELGIN MARBLES."

His lordship incurred the censure of Lord Byron, Dr. Clarke, and others, for having removed these glorious monuments of Grecian art from their original site, and has even been charged with a mercenary spirit for the manner in which he disposed of them. In answer to the first it may be said, without fear of contradiction, that within a very few years these precious remains, in the hands of their barbarian possessors, would have been consigned to destruction; and therefore his lordship was instrumental in rescuing them from the ravages of time and neglect. As to the second charge, of his lordship having been actuated by a mercenary spirit, it was calculated that at the time of the sale of the collection he had incurred an expense of more than double the amount received from Parliament, and that he lived and died an exile in comparative poverty. His death took place at Paris in 1842.

JAMES BRUCE, eighth Earl of Elgin, a distinguished statesman and diplomatist, and son of the preceding. He was born in London in 1811, and at the general election of 1841 entered Parliament as member for Southampton, but did not long remain there, as he succeeded to the earldom in the following year. Sir Robert Peel had formed a high opinion of the young nobleman's abilities, and he was almost immediately appointed governor-general of Jamaica —a post which he filled to the satisfaction both of the colonists and of the authorities at home. From Jamaica he was promoted in 1846 to the governor-generalship of Canada, where he remained for seven years; and his tenure of office was marked by the extinction of political discontent and the negotiation of an important treaty of commercial reciprocity between Canada and the United States. The Chinese complication arising out of the affair of the *Arrow*, required a diplomatic as well as a martial solution; and in the March of 1857 Lord Elgin was despatched as special plenipotentiary to China. Before, however, he arrived at Hong Kong he heard enough of the progress of the Indian mutiny to convince him that the quarrel with China was one of minor importance in face of the terrible crisis in Hindustan. With prompt and judicious daring he took upon himself the responsibility of diverting the Chinese expeditionary force from its original destination to India. He himself hastened from Hong Kong to Calcutta, where his presence was welcomed. As soon, however, as events permitted he returned to China. Canton was bombarded

and captured. On the 1st of January, 1858, the ambassadors formally took possession of the city. By a bold ascent of the Pei-ho, the court of Pekin was induced to yield, and on the 26th of June, 1858, was signed the treaty of Tientsin, which considerably improved the relations between Europe and China. The treaty of Tientsin signed, Lord Elgin proceeded to Japan, where, by an admirable mixture of firmness and conciliation, he negotiated a treaty which opened up that country to European commerce. On the death of Lord Canning Lord Elgin was appointed governor-general of India; but his health, which was much impaired by a constitutional complaint, soon gave way under the influence of a climate which had struck down so many of his predecessors. He died of heart disease at Dhurumsalla, whither he had gone a few weeks previously for change of air and quiet, 20th November, 1863.

ELGIN MARBLES, the designation given to a collection of ancient sculptures, chiefly from the Acropolis of Athens, whence they were obtained by Lord Elgin (who had been the English ambassador to Turkey) between the years 1801 and 1812. This collection was purchased in pursuance of an Act of the legislature, dated 1st July, 1816, for the sum of £35,000, and is now deposited in the British Museum, in a room built for its reception.

The Parthenon, or temple of Minerva, at Athens, whence the more important of these sculptures were obtained, was built during the administration of Pericles, about the year B.C. 448. It was constructed entirely of white marble from Mount Pentelicus; Callicrates and Ictinus were the architects; and the sculptures were produced partly by the hand and partly under the direction of Phidias. Two models of the Parthenon have been placed in the room, one of which represents the building in its ruined state, and the other restored to its perfect state, with the sculptures occupying their proper places.

The sculptures of the Parthenon in the Elgin collection contain the Metopes, most of which represent the combats of the Centaurs and Lapithæ; a portion of the frieze of the cella, which represents the Panathenaic procession; and the statues, or parts of them, from the tympana of the pediments.

The possession of the Elgin collection has established a national school of sculpture in our country, founded on the noblest models which human art has ever produced, and the nation is much indebted to the nobleman by whose exertions they were procured. If Lord Elgin had not removed them, the greater part would long since have been totally destroyed. In the last siege of Athens the Parthenon suffered additional damage.

ELI'JAH (Heb., God-Jehovah), one of the grandest and most romantic characters of sacred Jewish history, is called the "Tishbite, of the inhabitants of Gilead;" and this is literally all that is known of his parentage.

The principal events of his life are in connection with Ahab, king of Israel (B.C. 918), who had introduced the religion of his wife's countrymen—the worship of the Phœnician Baal—and he comes suddenly into view as a witness against this apostacy. His first recorded words are in prediction of a terrible famine, the duration of which is referred to in the New Testament (Luke iv. 25 and James v. 17) as having been three years and a half. To escape from the vengeance of Ahab and Jezebel, who naturally regarded Elijah as the author of the miseries brought upon the country, he took refuge by the brook Cherith, "before the Jordan," where, while he drank of the brook, he was fed night and morning by ravens, who brought him bread and flesh. When the brook dried up the prophet went to Zarephath, a Phœnician town near Zidon, where he was fed by a widow, whose hospitality and faith were rewarded by the miraculous increase of her meal and oil until the close of the famine, and by the restoration of her son to life. After three years Elijah emerged from his retreat and boldly confronted the king, who charged him with being the troubler of Israel and the cause of all the misery and wretchedness of the famine. Retorting the charge upon Ahab, the prophet challenged, or rather summoned, him to a decisive test as to who was the real troubler of Israel; and there took place upon Mount Carmel the grandest scene in the life of Elijah, and one without a parallel in the whole of sacred history as a typical embodiment for all time of the conflict between superstition and true religion. Two altars were to be erected, and the God that should answer by fire and consume the sacrifice thereon was to be acknowledged as the true Jehovah. From early morn till even the prophets of Baal invoked their god, working themselves into a mad and almost suicidal frenzy under the ironic taunting of Elijah at the uselessness of all their efforts. After taking every precaution to prevent the merest suspicion of fraud, Elijah now steps forward with the quiet confidence and dignity which became the representative of the true God. His prayer is short; he reminds God of his covenant, of his truth; and the answer is swift and signal. The fire falls, licks up the water, and consumes not only the bullock, but even the stones of the altar. The discomfiture of the priests of Baal is followed by their death at the hands of Elijah, and the vindication of Jehovah is complete. Ahab is bidden to return home, for there will soon be an abundance of rain. A little cloud shortly appears, and, becoming larger, covers the heavens and empties its fertilizing waters over the face of the country. Elijah accompanies Ahab to his palace, but if he hoped that such miraculous interpositions would soften the heart of Jezebel he is at once undeceived; for on hearing what had taken place, she sends a messenger to Elijah with a vow in the most solemn terms, that ere another day had passed his life would be even as the lives of the prophets of Baal. The courage of the prophet now apparently falters, and though he had been favoured with such remarkable tokens of the divinity of his commission, he quails before an idolatrous woman, flees into the wilderness, and prays for death. In the hour of his exhaustion and extremity he is miraculously supplied with food and drink, in the strength of which he journeys forty days and forty nights until he comes to Horeb, where he lodges in a cave. Here he has visions of God, and his courage is revived on learning, while he thought himself utterly alone, that there are still 7000 in Israel who have not bowed the knee to Baal. He is afterwards commanded to return to the wilderness of Damascus, to anoint Hazael king over Syria and Jehu king over Israel, and to appoint Elisha his successor in the prophetic office. Some time after this Elijah appeared again before Ahab to assure him that God would avenge the blood of Naboth, and that not only on himself, but his seventy sons should die, and Jezebel should become meat for dogs—predictions which were literally fulfilled. After Ahab's death Elijah had occasion to denounce the conduct of Ahab's son Ahaziah, who had sent to consult the oracle of Baalzebub at Ekron; and Ahaziah, to punish such an insult, despatched successively two armed bands to bring Elijah into his presence. At the prophet's word, however, fire descended from heaven and consumed them all. The captain of the third company implored mercy at the hands of the man of God, and found it; and the prophet then accompanied him to Ahaziah. Here Elijah personally announced to Ahaziah that death should follow upon his presumption and sin, and he accordingly died. The last public efforts of Elijah were expended upon the schools of the prophets at Bethel and Jericho, and finally he was taken up to heaven in a chariot of fire.

The Old Testament closes with a promise that Elijah should appear again before the coming of the Messiah, and some of the Jews, on seeing the miracles of Christ, said "He is Elias." Referring, however, to John the Baptist,

Christ said, "Elias hath come already." But though the prophecy was not fulfilled in a literal sense, Elijah appeared in the vision upon the mount of transfiguration as the representative of the prophets, together with Moses as the representative of the law, to do homage to Christ.

Elijah was one of the most eminent and honoured of the Jewish prophets, and his character as depicted in the Old Testament is marked by great moral grandeur. He comes suddenly upon our view without notice; he disappears by miracle. He wears the appearance of a supernatural messenger of heaven who had one work to do, with which his mind is absorbed, and the carrying out of which presents scenes the most extraordinary on record.

ELIMINA'TION. This word is from Lat. *eliminare*, to drive out of doors, and it is used in mathematics to signify the formation of an equation or equations which do not contain a certain quantity by means of given equations which do contain that quantity. Thus in so simple a case as $x=y$, $x=z$, if by means of these two equations we deduce the obvious result $y=z$, we have eliminated x, or formed a third equation in which x is not found.

ELIOT, GEORGE, the literary pseudonym of Miss Marian Evans (afterwards Mrs. Cross), one of the greatest of modern English novelists. She was born in 1819, at Griff, near Nuneaton, where her father was the steward of the estates of Sir Roger Newdegate. In 1841 her father removed to Foleshill, near Coventry, where she found opportunities for the study of Greek, Latin, Hebrew, French, German, Italian, and music. Less attracted by the arts than by philosophy, her mastery of German enabled her to gain a thorough knowledge of the modes of thought of the German school. In 1846 she published a translation of Strauss's "Leben Jesu," and in 1851 removed to London to assist in editing the *Westminster Review*. This engagement brought her into contact with George Henry Lewes, an enthusiastic advocate of the Positivism of Auguste Comte, and she lived with him until his death in 1879. In 1853 she published a translation of Feuerbach's "Wesen des Christenthums." From time to time she published short stories in *Blackwood*, which were collected in two volumes in 1858 under the title of "Scenes from Clerical Life." It was not, however, till 1859, when Miss Evans had reached her fortieth year, that her genius advanced to maturity. Then, by the publication of "Adam Bede," the anonymous writer woke one morning and found her *nom de plume* famous. In the later works which Miss Evans published there is much of the finer analysis, superior finish, and elaborate studies of character upon which critics like to dwell; but her fame will probably rest chiefly upon her earlier novels, and more especially on "Adam Bede." The reader is set down in a quiet English village, which is hardly stirred, even by the surging movement of the Methodist revival, and the chief interest centres around the two nieces of a tenant-farmer and the two sons of a village carpenter, these and other characters standing out with a lifelike distinctness which entrances attention till the very last word of the story is reached. The subsequent works of "George Eliot" were "The Mill on the Floss" (1860); "Silas Marner, the Weaver of Raveloe" (1861); "Romola" (1863); "Felix Holt, the Radical" (1866); "The Spanish Gypsy," a poem (1868); "Agatha," a poem (1869); "Middlemarch, a Study of Provincial Life" (1871-72); "The Legend of Jubal, and other Poems" (1874); "Daniel Deronda" (1876); "Impressions of Theophrastus Such" (1878). "Essays and Leaves from a Notebook" was published in 1884, after the author's death. These various works are mainly distinguished by philosophic thought, familiarity with the subtler processes of the mind, and with both the outer and inner life of English society. Her poems alone would have won for her lasting fame, but it is mainly her novels that will cause "George Eliot" to be remembered as the most distinguished among women in the history of English literature. She died on the 22nd December, 1880.

ELIOT, JOHN, often called the Apostle of the Indians, was a native of England, born in 1604. He was educated at the University of Cambridge, but having seceded from the Established Church and embraced the ministry, he emigrated, like many other sufferers for conscience, to New England, and arrived at Boston in 1631. He settled at Roxbury, near Boston, as minister of a small congregation, in which capacity he was zealous and efficient.

Having acquired the language of the Indians he commenced his missionary labours on the 28th October, 1646, and pursued them with so much earnestness and success that in 1674 there were seven Indian praying-towns, containing near 500 persons, settled in Massachusetts, besides a still greater number of converts who were not settled.

Eliot translated the Old and New Testament and several religious treatises into the Indian tongue, which were printed for distribution chiefly at the expense of the Society for Propagating the Gospel; he also wrote a number of English works. Eliot lived to the age of eighty-six, and resigned his pastoral charge at Roxbury only two years before his death, which took place in 1690.

ELIOT, SIR JOHN. If Hampden and "King Pym" are the heroes of the later phase of England's great fight for constitutional government under the earlier Stuarts, it must not be forgotten that it was Sir John Eliot's hand that fired the train long years before. He was born in 1590 of an old Devonshire family settled at St. Germans, and giving its name to Port Eliot there; and taking service under the crown, had risen to be vice-admiral of Devonshire. He was knighted on his appointment. He soon cleared our south-western coast of the pirates which infested it, especially capturing a famous rover called Nutt, the terror of those parts. This villain had been careful by lavish presents to make friends at court, and the all-powerful Buckingham threw the too successful admiral into prison for his pains. Probably the duke had a double motive in trying to crush Eliot, for the latter had come to Parliament in 1614 as member for St. Germans, Pym also being then first elected for Somersetshire. These two, and others like them, were the backbone of the Commons' resistance to James' demand of supplies. They refused a penny till "grievances" had first been heard, beginning with the illegal royal taxation. James had seized on the first pretext (some quarrel of theirs with the House of Lords) to dissolve them, but the attitude their leaders had induced them to take was never forgotten nor forgiven.

Eliot, though he did not take his degree when he studied at Oxford, was a man of considerable learning. His taste was exquisite, his imagination quick, his fancy poetical, his temper fearless; and in consequence his tongue, when he spoke on a subject he had at heart, was a very flame of fire. Added to this he was a true statesman, constant to his point through long years of repulse. It was small wonder that where such an one led men enthusiastically followed. As Hallam, usually so frigid, says:—"He (Eliot) was the most illustrious confessor in the cause of liberty which that time produced."

When Eliot had been released from his unjust imprisonment he found no difficulty in being re-elected to Parliament. James, oblivious of the Armada and of the eternal feud between Protestant and Catholic, pressed on a Spanish policy from motives of statecraft. Prince Charles was affianced to the Infanta. In vain the Commons protested by deputation from the Parliament of 1621. "Bring stools for the ambassadors," was the king's retort to those he considered mere meddlers in things above them, and he at once dissolved that Parliament. When the exchequer was empty and a new Parliament was perforce summoned

in 1623, the Commons as usual insisted on grievances being heard before payment of supplies, and the first thing they impeached was this wicked policy of an unnatural alliance with Spain, the detested home of the Inquisition. Prince Charles had personally broken with the Spanish court, and Buckingham, to stop the clamour, threw Cranfield, the treasurer, as a sop to the barking dogs. Eliot urged his condemnation. "The greater the delinquent the greater the delict," said he. "They are a happy thing, great men and officers, if they be good, and one of the greatest blessings of the land; but power converted into evil is the greatest curse that can befall it." Thus did this keen statesman first formulate the great principle of our liberty, the responsibility of the royal ministers to Parliament. Cranfield beheaded, Eliot still pressed on till Charles, now newly king, perceived his drift at last. "I see you chiefly aim at the Duke of Buckingham," he replied to a sterner remonstrance of Eliot's than usual. The answer of the Commons to the king's rebuke was the formulation of the set charges against the duke and the resolute withholding of supplies. Charles threatened them with dissolution. They retorted by impeaching the duke and sending the cause to the Lords. It was Sir John Eliot who conducted the case, and he performed his task in so magnificent and high-toned a piece of invective that its equal is difficult to find. The duke's greed and his lavishness, his ambition and his meanness, his seizure of all authority and his neglect of every duty, warranted the terrible parallel with Sejanus, the minister of Tiberius, drawn by the fearless Commoner. The king flew to the excited, admiring House, flung Eliot into the Tower, and stayed the trial. The Commons ceased business altogether for ten days, till Charles, forced by pressing necessities, released their champion. Eliot, free, at once proceeded to draw up a Remonstrance. Charles burned it, dissolved the Parliament, and deprived its author of his vice-admiralty. He then, by an act of pure despotism, demanded taxes from the people directly. The whole land refused, save here and there, to give him money "except by way of Parliament." John Hampden was summoned before the council, and began his famous career. Foiled on all sides, and almost bankrupt, Charles had to call the Parliament of 1628. Eliot stirred the new Commons by his matchless eloquence, but calmer counsels prevailed; and setting aside his designs, the Commons first drew up the famous Petition of Right. When, however, the king prevaricated, hesitated, evaded any direct reply, the angry Commons slipped the leash, and Eliot rushed once more to the front with a "Short Remonstrance" of such unprecedented boldness, that the Speaker commanded him (under a royal order) to be silent. Eliot ceased speaking abruptly, in a pause of solemn silence, succeeded by a scene of wild excitement at this last and crowning insult to English liberty, in the midst of which the Remonstrance was passed, with the hated duke's name in the forefront of it. Charles hurriedly agreed to the Petition of Right, would have agreed to anything, to prevent the presentation of this terrible Remonstrance, and to save his favourite. In the long duel between the all-powerful vizier of England and a simple Commoner with only right on his side, the Commoner had won. Next Eliot led the attack on Laud and the High Church party, who were pressing back the English Church Romewards; and Oliver Cromwell made his first speech in support. Charles sent to dissolve the unruly Parliament, but his message of summons was met by locked doors, while the members held down Speaker Finch in his chair, and Eliot delivered his last famous harangue, the text of which was, "None have gone about to break Parliaments but in the end Parliaments have broken them." Terrible prophecy, fulfilled to the letter. With emphatic resolutions against Laud's Arminianism, against Papistry, against illegal taxation, against arbitrary government in any form, the Commons separated as the soldiers arrived. Charles called them "vipers" in his dissolution proclamation; and summoned no Parliament for eleven years. Eliot, once outside the House, was thrown into the Tower, and treated with such excessive harshness that he soon died there, the first of our constitutional martyrs, in 1632. Forster's "Life of Eliot" (London, 1863), and the fine spirited sketch in Green's "Short History of the English People" (London, 1876), at length do justice to the first leader of the great fight.

E'LIS or **ELEI'A,** a district of the Peloponnesus included between Achaia, Arcadia, Messenia, and the Ionian Sea. Elis was originally divided into three parts—the northern, called Cœle or "hollow" Elis; the southern, Triphylia; and that in the middle, Pisatis. The Eleans were the first people in the Peloponnesus who experienced the effects of the Dorian invasion, as their territory was the landing-place of the invaders, and was assigned by them to their ally, the Ætolian Oxylus. Oxylus and his new subjects conquered Pisa and Olympia, where the Olympian games were established about 1104 B.C., though they were not regularly celebrated till Corœbus gained the prize in 776. Those games exercised a most important influence on the subsequent destinies of Elis. In the earlier periods the people of Pisa, which was in the neighbourhood of Olympia, sometimes presided over the celebration of the games; but the wars between Messenia and Sparta enabled the Eleans to form a connection with the Spartans, which ended in a tacit understanding that the intervening sea-coast should be divided between the two powers; the resistance of the Pisatæ only brought upon them the destruction of their city and the annexation of all Triphylia to Elis. The harmony between Elis and Sparta was interrupted during the Peloponnesian War by the countenance which the Spartans afforded to the Lepreatæ, and the Eleans endeavoured to avenge this interference by excluding the Spartans from the Olympic games. After some years of misunderstanding they were compelled to return to the Spartan alliance by the invasion of Agis. In 365 they were engaged in a war with the Arcadians, which deprived them of almost all their southern territories. The Eleans were firm supporters of the Ætolians during the Social War, and never joined the Achæan League.

The city of Elis was originally called *Ephyra.* The site of the ancient capital is now Paleopoli. The ruins consist of several masses of Roman tile and mortar, with many wrought blocks of stone and fragments of sculpture scattered over a space of 2 or 3 miles in circumference. The soil was sandy, argillaceous, or a rich mould. The territory was fertile. Its principal rivers are the Alpheius (Rofea) and the Peneius (Gastuni). The principal seaport of Elis was Cyllene, the modern Chiarenza.

ELISABETH, MADAME, a kindly affectionate figure in a troublous time, is the name by which we know the amiable sister of Louis XVI. She accompanied the king and queen in their ill-fated flight to Varennes in June, 1791, and shared their capture and ignominious haling-back to Paris. She was by her brother's side when on 10th August, 1792, he left the Tuileries to ask protection of the Assembly, while his faithful Swiss Guard were being butchered behind him; was conducted with him and the queen to the Temple-prison, shared their long torture there, and, alas, their fate. She who had never injured anyone in the world, and who even spent her last moments in comforting her fellow-passengers along the streets in the fatal tumbril, was condemned "for plots" with bitter irony, and executed 22nd April, 1794. Danton's head had fallen on the 5th. Had he lived we may hope the terrible crime of the execution of gentle "Madame Elisabeth" would not have stained the annals of France.

ELI'SHA (Heb., God the Saviour or Deliverer), the successor of Elijah, was a native of Abel-meholah, a village

in the tribe of Issachar, in Galilee. He was found in the act of ploughing by Elijah, who threw his mantle over him, a symbolical action indicating his being clothed with the spirit, and an indication of his call to the prophetic office. This occurred some time before the death of Ahab, and Elisha survived until the reign of Joash, his official career thus extending over a period of nearly sixty years. His life presents a strong intermixture of the miraculous, and in this respect he widely differs from most of the other prophets, with whom spiritual teaching seems the primary function, miracles being only accessory. With Elisha, on the other hand, miracles seem to be the primary function, and the spiritual teaching is subsidiary. The miracles differ widely in their general character from those of Elijah, who was the messenger of vengeance, sudden and fierce; while the miraculous works of his successor were rather those of mercy and of restoration. The wonder-working power is represented as continuing even after his death, a dead man cast into Elisha's sepulchre being quickened by mere contact with his bones. The personal characteristics of the two men are also at opposite extremes. Elijah is the prophet of the wilderness, rugged, austere, and of supernatural mien, distinguished by his fiery zeal against all that opposed Jehovah. Elisha is the prophet of civilized life, of the court and the city, mild and tolerant; he is the "holy man of God which passeth by us continually," mixing in the common life of the people, and promoting the advancement of the kingdom of God in its ordinary channels of mercy, righteousness, and peace. The leading events in the history of Elisha are narrated in 2 Kings ii.–xiii.

ELI'SION is the shortening of words by omitting a letter or a syllable. It is called *syncope* if it occurs in the middle of a word, *apocope* if at the end, *aphæresis* if at the beginning. These are terms of the Greek grammarians. Elision occurs chiefly in the course of the passage of words from a mother tongue to its derivative, and is one of the most interesting branches of the absorbing study of etymology. A few instances are subjoined as examples—

Syncope.—Greek, κάμινος; French, cheminée; English, chimney. Latin, gaudia; Italian, gioia; English, joy. Latin, periculum; Italian, periglio; English, peril. Latin, presbyter; Old French, prestre; English, priest. Latin, mores; French, des mœurs; English, demure.

Apocope.—Latin, pagina; French, page; English, page. Latin, avis struthio; French, autruche; English, ostrich. Old English, bycgean; Modern English, buy. Greek, σμαράγδος; Old French, esmeralde; English, emerald.

Aphæresis.—Latin, avunculus; French, oncle; English, uncle. Latin, incensorium; French, encensoir; English, censer. Latin, excorticare; Old French, escorcher; English, scorch.

Don't, sha'n't, &c., are common specimens of elision of another kind. The modern tendency is to look upon them as vulgarisms, but formerly, especially in the Elizabethan era, the tendency lay rather the other way. *Zounds* served for "By God's wounds," *gramercy* for "I cry you mercy," *gaffer* for grandfather, *gammer* for grandmother, &c. "I'll put you to't," "Nay, then, do't," "Let 'em come on," and the like, were rife, even to harshness. The poet Browning alone among the greater of the moderns pushes the trick of elision to extremes, rarely, if ever, failing to use *o'th'* for "of the," or *i'th'* for "in the," &c., if occasion present itself.

ELIX'IR, in pharmacy, a name formerly applied to various compound tinctures, and to preparations supposed to contain the essence of other substances. It is still applied to several popular remedies. The elixirs of the alchemists were solutions employed in their fruitless attempts to transmute the baser metals into gold.

ELIZABETH, Queen of England, the daughter of Henry VIII. by his second wife, Anne Boleyn, was born at Greenwich, 7th September, 1533. Her right of succession to the crown was the subject of several Acts of Parliament. Soon after her birth, the 25 Henry VIII. c. 22, settled the crown on her and her heirs in default of male issue by Anne Boleyn; by the 28 Henry VIII. c. 7, both Elizabeth and Mary were bastardized, the marriages whence they proceeded being declared unlawful and void; the 35 Henry VIII. c. 1, however, settled the crown in succession on Edward, Mary, and Elizabeth. Edward nevertheless passed over both Mary and Elizabeth in the will he made before his death; and Mary, by the Act 1 Mary, st. 2, c. 1, again bastardized Elizabeth, by enacting that the divorce of Catharine of Aragon by Henry was altogether void.

In 1546 an unsuccessful negotiation was entered into for the marriage of Elizabeth to Philip of Spain, son of the Emperor Charles V. Philip afterwards became the husband of her sister Mary. Another unsuccessful negotiation was entered into with respect to the Duke of Angoulême, the third son of Francis I. of France. Elizabeth's next suitor was the protector Somerset's unfortunate brother, the Lord Seymour of Sudley, to whom it is said Elizabeth allowed freedoms that gave much uneasiness to Seymour's wife, Queen Catharine Parr; and it was part of the charge on which Seymour was attainted and executed, that he had plotted to seize the person of Edward VI., and to force Elizabeth to marry himself. In 1550 it was proposed that Elizabeth should be married to the eldest son of Christian III. of Denmark; but the princess refused to consent to the match. At this period of her life Camden has given an interesting account of the situation and employments of Elizabeth. He says that before she was seventeen years of age she understood well the Latin, French, and Italian tongues, and had an indifferent knowledge of the Greek. Neither did she neglect music, so far as it became a princess, being able to sing sweetly and play handsomely on the lute.

On the accession of her elder sister, the Roman Catholic Mary, Elizabeth was for a time treated with great favour. At the coronation, in October, 1553, Elizabeth and the Lady Anne of Cleve followed in a chariot next to that of the queen; and one account says that Elizabeth carried the crown on that occasion. Her position, however, was one of great difficulty. Looked up to as the head of the Protestant party, and offending Mary by refusing to attend mass, she gladly availed herself of the pretext for retiring from court afforded her by Mary assigning her a rank below what her birth entitled her to after the passing of the Act which declared her mother's marriage illegal. She went to Ashridge, in Buckinghamshire. Thence she was fetched by a party of horse on 8th February, 1554, immediately on the suppression of Wyatt's attempt, in which she was accused of being implicated. She was kept in close confinement at Whitehall for some time, and then committed to the Tower on 11th March. She remained in close custody for about a month, after which she was allowed to walk in a small garden within the walls of the fortress. On the 19th of May she was removed, in charge of Sir Henry Bedingfield, to Woodstock. She remained at Woodstock till April, 1555, when she was, on the interposition, as it was made to appear, of King Philip, allowed to take up her residence at the royal palace at Hatfield, under the superintendence of a Catholic gentleman, Sir Thomas Pope, by whom she was treated with respect and kindness.

She continued to reside at Hatfield till the death of Mary, which took place 17th November, 1558. Both houses of Parliament met, acknowledged her as Mary's successor by acclamation, and as soon as the houses rose the proclamation took place. Elizabeth came to London on Wednesday the 23rd: she was met by all the bishops in a body at Highgate, and escorted by an immense multitude of people of all ranks to the metropolis, where she took up her lodgings at the residence of Lord North, in the

Charter House. On the afternoon of Monday the 28th she made a progress through the city in a chariot to the royal palace of the Tower; here she continued till Monday the 5th December, on the morning of which day she removed by water to Somerset House. Elizabeth's first act was to recall the celebrated William Cecil to the office of secretary of state, which he had already held under Edward VI., and she soon after created Nicholas Bacon (father of the chancellor) keeper of the great seal. Cecil became lord high treasurer in 1572, and with Walsingham was the queen's principal adviser in all state matters till his death in 1598.

The affair to which Elizabeth first applied her attention was the settlement of the national religion. The opinions of Cecil strongly concurred with her own in favour of the reformed doctrines, to which also undoubtedly the great mass of the people was attached; and a succession of Acts were gradually passed, and measures taken, by which this object was effected, though not without considerable opposition both from the Roman Catholic party and the Puritans, the latter of whom had been gathering strength and numbers even from the commencement of the Reformation. Her first Parliament repealed the Statutes of Heresy, dissolved the monasteries which had been refounded, deprived Mary's bishops of their office, restored the royal supremacy, and established the church on the prayer-book of Edward VI. and the thirty-nine articles. Against the Roman Catholics most severe measures were taken. By an Act passed in 1585 (27 Eliz. c. 2) every Jesuit or other Catholic priest was commanded to depart from the realm within forty days, on pain of death as a traitor, and every person receiving or relieving any such priests was declared guilty of felony. Under this law and the Act of Uniformity many priests and others were executed, and much violent persecution was carried out. At the same time Elizabeth always used the crucifix in her own chapel, refused to be argued with about "Real Presence," &c., and indeed it would seem was Protestant by statecraft rather than by conviction. Her own "advertisements," &c., are so curiously halting that in our own day both High Church and Low Church appeal to them alike.

It was the struggle with popery that moved and directed nearly the whole policy of her reign, foreign as well as domestic. When Elizabeth came to the throne she found the country at peace with Spain, but at war with France. Philip, the late queen's husband, and Elizabeth's brother-in-law, with the view of preserving his English alliance, offered himself to Elizabeth in marriage almost immediately after her accession, but she declined the offer. A general peace, however, comprehending all the three powers and also Scotland was established in April, 1559, by the treaty of Cateau Cambresis. Scarcely, however, had this compact been signed when the war was suddenly rekindled, in consequence of the assumption by the new French king, Francis II., of the arms and royal titles of England, in right, as was pretended, of his wife, the young Mary Queen of Scots. Elizabeth instantly resented this act of hostility by sending a body of 5000 troops to Scotland, to act there with the Duke of Chatelherault and the Lords of the Congregation, as the leaders of the Protestant party called themselves, and the French king was speedily compelled both to renounce his wife's pretensions to the English throne and to withdraw his own troops from Scotland, by the treaty of Edinburgh, executed 7th July, 1560. Francis died before the end of the year, but Elizabeth continued to assist the Huguenot party with men and money.

The history of Mary Stuart, and of the affairs of Scotland during her reign and that of her son, must be reserved for a separate article. Philip of Spain had been long alienated from Elizabeth by her proceedings in favour of the reformed religion, and a series of ill-offices and intrigues had taken place on both sides, though not amounting to an open war. Philip had befriended the rebellions in Ireland and attempts in England in favour of Mary; Elizabeth had espoused the cause of the people of the Netherlands, whither she had sent the Earl of Leicester, and an English fleet had attacked and ravaged the Spanish settlements in the West Indies. At last, in the summer of 1588, the great Spanish fleet, arrogantly styled the "Invincible Armada," sailed for the invasion of England, and the greater part of it was dashed to pieces on the coasts which it came to assail. [See ARMADA.] From this time hostilities proceeded with more or less activity between the two countries during the remainder of the reign of Elizabeth; and it was rather in opposition to Philip, who supported the league, than for his own sake, that Elizabeth gave assistance to Henry IV. of France. In May, 1598, Henry concluded a peace with Philip, who died in September of the same year. But the war between England and Spain continued. In 1601 the new king, Philip III., sent a force to Ireland, which landed in that country and took the town of Kinsale; and the following year Elizabeth retaliated by fitting out a naval expedition against her adversary, which captured some rich prizes and otherwise annoyed the Spaniard. Her forces continued to act in conjunction with those of the "Seven Provinces" of the Netherlands, both by sea and land.

Elizabeth died on the 24th March, 1603, in the seventieth year of her age and the forty-fifth of her reign. One of the first requests addressed to her by the Parliament after she came to the throne was that she would marry, but she persisted in remaining single to the end of her days. Yet she coquetted with many suitors almost to the last, using her hand as a valuable means of diplomacy—a proposal of marriage being almost as good as a treaty. Among those who aspired to her hand were Philip of Spain; Charles, archduke of Austria (a younger son of the Emperor Ferdinand I.); James Hamilton, earl of Arran, the head of the Protestant party in Scotland; Eric XIV., king of Sweden (whom she had refused in the reign of her sister Mary); Adolphus, duke of Holstein (uncle to Ferdinand II. of Denmark); Charles IX. of France; the Duke of Anjou; and the Duke of Alençon; and Camden mentions some English subjects who had "golden dreams of marrying their sovereign." Her first and greatest favourite was Robert Dudley (afterwards Earl of Leicester), a younger son of the Duke of Northumberland. Leicester continued the royal favourite till his death in 1588, disgracing by his profligacy the honours and grants that were lavished upon him by Elizabeth. Very soon after the death of Leicester the young Robert Devereux, earl of Essex, whose mother Leicester had married, was taken into the same favour that had been so long enjoyed by the deceased nobleman; and his tenure of the royal partiality lasted, with some intermissions, till he destroyed himself by his own hotheadedness and violence. He was executed for a frantic attempt to excite an insurrection against the government in 1601.

Both the personal character of Elizabeth and the character of her government have been estimated very differently by writers of opposite parties. She was undeniably endowed with great good sense, and with a true feeling of what became her station. Many of the least respectable mental peculiarities of her own sex were mixed in her with some of the least attractive among those of the other. Extravagantly fond of rich dresses, jewels, and gorgeous processions, she was also extremely economical. Her selfishness and her vanity were both intense; and of the sympathetic affections and finer sensibilities of every kind she was nearly destitute. At the same time she loved her people as her very self. Her old age was miserable, far more because her people had ceased to love her than because her favourite Essex had shown himself a traitor. She refused the proffered sovereignty of the Netherlands

lest it should damage England. In her speech to her first Parliament she ended thus:—"Nothing, no worldly thing under the sun, is so dear to me as the love and goodwill of my subjects." In her reign England became Puritan, and the pure worldliness of the great queen gradually alienated in temper those subjects whose loyalty never wavered.

Her literary knowledge was certainly very considerable; and if she was one of the most eccentric women of her time she was also one of the most accomplished, and, in spite of her notorious amours, could subordinate the gratification of her passions to that of her intellect. The policy of her reign was guided by her responsible statesmen, like the Cecils, and not by profligate favourites, such as Leicester and Essex. Of Elizabeth's literary compositions (a few of which are in verse) none are of much value, nor evidence any very superior ability, with the exception, perhaps, of some of her speeches to the Parliament.

ELIZABETH PETROV'NA, daughter of Peter the Great and of Catharine I., was born in the year 1709. After the death of her nephew Peter II. in 1730, she declined the crown in favour of her cousin Anna. After the death of Anna in 1740, Ivan, the infant son of the Duke of Brunswick and of Anne, niece to the late empress, was proclaimed emperor, but was set aside by a military insurrection in 1741. Elizabeth was proclaimed empress, and Anne and her husband, the Duke of Brunswick, and the child Ivan were put in confinement. Several noblemen were sent into Siberia. Elizabeth took an active part in the war of the Austrian succession, and sent troops to the assistance of Maria Theresa, and she afterwards concurred in the peace of Aix-la-Chapelle in 1748. During the Seven Years' War Elizabeth took part against Frederick of Prussia with considerable success, but her illness and death retrieved the fortunes of Frederick. She died in December, 1761, after a reign of twenty years, and was succeeded, as she had herself arranged, by the Duke of Holstein-Gottorp, son of her sister Anna Petrovna, duchess of Holstein; he assumed the title of Peter III.

Elizabeth exerted herself to forward the compilation of a code of laws for the Russian Empire, a task begun under Peter the Great, but which was not completed till the reign of Catharine II. She was extremely orthodox in religious outward observances, but her conduct was scandalously immoral: though unmarried she had several children.

ELIZABETH'AN ARCHITECTURE. By this name we distinguish that transition style which prevailed in England from about the middle of the sixteenth to the end of the first quarter of the seventeenth century, and was accordingly in its meridian during the long reign of Elizabeth. It was applied exclusively to domestic or at least secular buildings, in which respect it was very differently circumstanced from the Gothic style, which was almost as exclusively ecclesiastical in character and purpose. The age of Elizabethan architecture was that of palace-building, and a style developed itself which was eminently palatial in many of its qualities. The latest development of perpendicular Gothic, peculiar to England, and often called "Tudor," is the basis of this style, but upon that is grafted all that is peculiar to the Renaissance, and in addition a free use of the gable as a means of decoration. In the Elizabethan architecture the classical "orders" are usually applied only to parts of a front; for instance, the centre, which is marked out as a lofty frontispiece or portal ornamented with several tiers of columns, and thus not only distinguished from the rest, but in many instances rendered quite distinct from it, all besides being comparatively genuine Tudor, without any intermixture of foreign elements. Even where such is not the case, the Tudor physiognomy manifests itself in windows and bays, which last are almost as peculiar to our English architecture of the period as small circular towers and turrets with conical or spire-like roofs are to that of Flanders and France. Although square-headed, and without tracery of any kind, the windows retain a good deal of the latest Gothic or Perpendicular character, being divided by mullions and transoms into numerous compartments after the manner of panelling, a mode that freely admits of a window being made of any extent; and not only are single windows sometimes exceedingly spacious, but are put so closely together as to render the whole of a front nearly all window.

The most remarkable characteristic of this style is the gable, a feature singularly diversified. Almost every imaginable combination of curves, both concave and convex, with straight lines and angles, are to be met with in gables. Differently shaped gables often occur in the same building, and produce very great effect of outline, which is further increased by embellished parapets with balls and other ornaments upon them, by small domes or turrets, and by chimney-shafts, all which, mingled together in glorious confusion, frequently lend an air of picturesque magnificence to what are otherwise rather plain and homely structures, and impart animation to what would else be lumpish masses. In like manner porches and balustraded terraces often give character to the lower part of a building, while the upper may be comparatively flat and uninteresting. The style is well adapted for brick and stone, the contrast of colour seeming natural to it, and serving to bring out the several parts more distinctly. There are also many instances of brick alone being employed, the ornamental parts being formed of moulded bricks; and though the effect is comparatively sombre, it is by no means unpleasing.

To the internal characteristics of the Elizabethan style belong spacious bay-windows; long and ample galleries, but generally of low proportions; massive and elaborately sculptured chimney-pieces; screens of similar character, either with open arches or doors; wainscoted and panelled walls; ceilings highly enriched, and sometimes arched, and entirely covered with scroll-work foliage; and wide staircases with richly carved balustrades. The prevailing character is that of heaviness and stateliness, on which account it is ill suited for literal imitation at the present day, especially for houses upon a moderate scale, or for small rooms.

ELK or **MOOSE** (*Alces malchis*), the largest of the DEER family, is a native of the northern regions of both hemispheres. It is most abundant in North America. In Europe it is thinly spread through the wild forest regions of Norway, Sweden, Lithuania, and Russia. It extends also through Asiatic Tartary to the north of China. It is a large and ungainly-looking animal, standing about 6 feet at the shoulders, and furnished with massive palmated horns, which occasionally weigh upwards of 60 lbs., and spread out laterally over a space 6 feet in width. The head alone measures upwards of 2 feet from the tip of the muzzle to the occiput, the nose being hairy and swollen out at the upper border. The eyes are small, the ears long, the neck short and stout, and provided with a coarse mane, the body short and rounded, and the tail only 3 or 4 inches in length. The legs, especially the front limbs, are long. The fur is exceedingly coarse, rough, and wiry. Respecting the habits of the elk, we may observe that it is naturally very timid, and when taken young is easily domesticated. The male loses his timidity during the rutting season, and then will attack any animal that comes in his way, and even man himself if provoked. Its movements look awkward as it glides along in a kind of shuffling, ambling trot, but when severely pressed it gallops with great rapidity. During the warm season it is gregarious, and frequents low swampy grounds, often taking the water, through which it swims with marked facility, resorting in cold weather to sheltered forests. The flesh of the elk is highly esteemed, and the hide extremely valuable. The elk is figured in the Plate DEER.

ELK, IRISH. See MEGACEROS.

ELL (from Lat. *ulna*, a bone of the forearm), a measure of length now almost disused. The three ells which have preserved a place in our arithmetical works—the Flemish, English, and French—are respectively three, five, and six quarters of a yard. The measure was originally taken in some way from the arm, and hence its different lengths. Ell is the *el-* in *elbow*, and no doubt was originally the length of the forearm from elbow to finger tip.

EL'LAGIC or **BEZOARDIC ACID**, an acid found in certain animal concretions known as bezoar stones, and from these it is obtained as ellagate of potassium by dissolving in caustic potash. The acid is separated from this potassium salt by precipitating the solution with hydrochloric acid. It may also be obtained from infusion of gall-nuts, by exposure to the air, thus resulting from the decomposition of the gallic acid. It is a light yellow crystalline powder, soluble in alcohol, but insoluble in water. It forms inky-black compounds with iron salts. The formula is $C_{14}H_6O_8$. A number of salts called ellagates are known.

EL'LENBOROUGH, EARL OF (EDWARD LAW), son of Lord Chief-justice Ellenborough, was born in the year 1790. After an education at Eton and Cambridge he entered Parliament in 1814 for the since disfranchised borough of St. Michael's, but was soon removed to the Upper House on succeeding his father as Baron Ellenborough in 1818. He first took office in 1828 as lord privy seal in the Duke of Wellington's administration. In 1834 he was appointed president of the Board of Control in Sir Robert Peel's government; and when that statesman again became premier in 1841 Lord Ellenborough returned to his former post. About a month afterwards he was offered and accepted the post of governor-general of India, vacant by the recall of Lord Auckland. He reached India in 1842 in the midst of a crisis little less threatening in its aspect than that of the mutiny of 1857; but the vigorous policy which he adopted soon restored public confidence and brought back the prestige of our arms. Under his administration in India was undertaken the expedition into Afghanistan under Generals Pollock and Nott, which resulted in the recapture of Ghuznee and Cabul, and the rescue of Lady Sale and the other British captives. The conquest of Scinde by Sir Charles Napier, in 1843, was undertaken and carried out by Lord Ellenborough's government; the Marhattas were also reconquered and reduced to obedience. His policy, however, was not approved of by the court of directors of the East India Company, and he was recalled by that body in the exercise of their legal powers. The Duke of Wellington, however, warmly defended Lord Ellenborough's policy in Parliament; and on his return home he was created an earl and decorated with the Grand Cross of the Bath. From January to July, 1846, he filled the post of first lord of the admiralty in Sir Robert Peel's administration; and in 1858 he undertook for two months, under Lord Derby's administration, his former office of president of the Board of Control. After this time he did not take office, but continued to be a most powerful and eloquent speaker in the House of Lords. Lord Ellenborough died December 22, 1871.

EL'LESMERE, a market-town of England, in the county of Salop, with a railway station on the Cambrian line, is 15 miles N.N.W. from Shrewsbury, and 182 from London. The town is neat and clean, and is beautifully situated near a lake (mere), well stocked with fish, and about 150 acres in extent. The church is large, with a central tower and a very fine east window. There are also dissenting chapels and a town-hall. Much good butter and cheese are made in the neighbourhood. Malting is the staple trade of the place. The town gives the title of earl to the Egerton family. The population of the parish, which extends into Flintshire, in 1881 was 5452. The Ellesmere Canal, by which the town is connected with Welshpool, Chester, and the Mersey, was considered when constructed as the grand engineering feat of the day.

EL'LIOTT, EBENEZER, the *Corn-law Rhymer*, was born at Masborough, Yorkshire, on 7th March, 1781. His father Ebenezer, who held the position of clerk in an iron-foundry, was a man of strong character and vigorous intellect, though somewhat bigoted and narrow in his theological views. The young Ebenezer was but a dull scholar during the earlier years of his childhood, but he afterwards developed a strong love of reading and a taste for the beauties of nature. At the age of seventeen he published his first poem, entitled the "Vernal Walk," and this was soon followed by "Night, or the Legend of Wharncliffe," "Tales of Night," &c. In 1821 he commenced business as an iron-founder at Sheffield. He pursued this avocation with great success for a period of twenty years, retiring in 1841 to an estate which he had purchased at Great Houghton, near Barnsley, where he died 1st December, 1849. He was an earnest advocate of free trade, and one of the most determined opponents of the corn laws, one of the best of his works being the "Corn-law Rhymes," the third edition of which appeared in 1831. Other works are the "Village Patriarch," "The Ranter," and "Corn-law Hymns." In 1834 he published a collected edition of his works in three volumes, and in 1840 an edition in one volume. As a poet he resembles Crabbe more nearly than any other of the British poets, but his lines are instinct with an energy and power that are all his own. An earnest reformer and steadfast champion of the poor, he thought more of relieving the latter from oppression than of the polish of his lines, but many of his descriptions of Yorkshire scenery are replete with interest and beauty.

ELLIPSE. This curve, which is one of the CONIC SECTIONS, ranks next in importance to the circle (which is itself an extreme form of the ellipse) and the straight line. An ellipse is easily drawn in the manner described under ELLIPTIC COMPASSES.

Scientifically stated the ellipse is that circumference which is shown when a right cone is cut obliquely by a plane passing through both sides of it; if the plane is horizontal the limit of the ellipse called a circle is produced. An ellipse is found to be the *locus* (or aggregate series of positions) of a point which moves so that its distance from a given point is always less by a certain ratio than its distance from a given straight line.

Thus let A be the moving point, which moves in every direction possible, so that the distance, A S, to the fixed point S is half the distance from the fixed line Y Y. Let A′ be any other point, then if A′ O′ (perpendicular to Y Y) be twice A′ S, A′ is a point on the ellipse. It is evident that for every point *above* the line of the major axis, of which A S is part, there is a corresponding point below it, as shown in the figure, where A″ O″, A″ S are exactly equal to A′ O, A′ S. It will be found after a certain length of upward curve that the locus descends again in an exactly similar downward curve to the major axis, so that an ellipse is not only divisible horizontally by its *major axis* (of which A S is part) into two parts precisely equal and similar, but is also divisible vertically by a vertical line,

called the *minor axis*, into two parts precisely equal and similar. The straight line Y Y is the *directrix*, and the fixed point S is the *focus* of the ellipse.

The equation to the ellipse is as follows, expressed by *co-ordinates*. With the point O as origin, p being the distance O S, e the given ratio of A S to A O, and $x\ y$ the co-ordinates of the moving point A, the equation is readily found (by Euclid I. 47) to be

$$y^2 + (x-p)^2 = e^2 x^2.$$

Or if the *vertex* of the curve, which is the point A, be taken as the origin, and the whole length of the major axis be called $2a$, the equation becomes

$$y^2 = (1-e^2)(2ax - x^2).$$

Finally, if the origin be taken at the intersection of the major and minor axes, which is called the *centre* of the ellipse, and a denotes as before half the major axis, while b denotes half the minor axis of the ellipse, the equation then becomes

$$y^2 = \frac{b^2}{a^2}(a^2 - x^2), \text{ or } \frac{x^2}{a^2} + \frac{y^2}{b^2} = 1,$$

whence, by the integral calculus, it readily follows that the area of an ellipse is $\pi a b$, where π is the well-known 3·1415926, the ratio of the circumference to the diameter of a circle.

The length of the circumference of an ellipse may be approximately found to any required degree of accuracy by extending the following formula:—

$$\pi\left[1 - \frac{d^2}{2^2} - \frac{3d^2}{2^2 \cdot 4^2} - \frac{3^2 \cdot 5d^2}{2^2 \cdot 4^2 \cdot 6^2} - \&c.\right],$$

wherein π is the fraction 3·1415926, &c., and d is the fraction $\frac{1-4b^2}{4a^2}$, $2a$ and $2b$ being as before the major and minor axes of the ellipse respectively.

It follows from what has been said that there is at the other extremity of the major axis another *vertex* precisely similar in relative position to the vertex A. So also is there another point to the right of the centre precisely similar to the *focus* S, and another line may be drawn beyond the ellipse to the right, precisely analogous to the *directrix* Y Y. The centre of the ellipse, lying as said at the intersection of the major and minor axes, will be found exactly to bisect the line joining the foci, and also to bisect the largest diameter, or major axis, in which the foci lie. In fact, it bisects every diameter of the curve, which is why it is called the centre. See ECCENTRICITY, ELLIPTICITY.

The striking use of this curve lies in its being the nearest representative of a planetary orbit which can be given in a simple manner. If the planets did not attract each other, but were only attracted by the sun, they would describe absolute ellipses. Their mutual actions being small compared with that which the sun exerts, they consequently move in ellipses *very nearly*.

The reader who is not versed in geometry must remember that though an ellipse be an *oval*, yet an oval is not necessarily an ellipse. An oval figure may be formed by arcs of circles which shall have the appearance of an ellipse but none of its properties.

ELLIP'SIS signifies the omission of a word necessary to complete a sentence or expression in a strictly grammatical form.

ELLIP'TIC COM'PASSES, the name given to any machine for describing an ellipse. A simple method of forming the curve is to fasten a pin in the paper at each of the two foci, and to attach to the pins the opposite ends of a thread whose length is equal to the major axis of the ellipse. Then, if a pencil move in such a way as to keep the thread always stretched, it will describe an ellipse: since one of the properties of an ellipse is that the sum of the focal distances of any point on the curve, that is, its distance from one focus added to its distance from the other, is always equal to the major axis.

The ordinary machine consists of two bars of metal at right angles to one another, in each of which is a groove; two pins in a ruler, of which one extremity carries a pencil, are made to travel in the grooves, when the motion of the ruler causes the pencil to describe an ellipse. The distances of the pencil from the two pins are made equal to the semiaxis of the curve.

ELLIP'TIC POLARIZA'TION, in the undulatory theory, is a name given to a supposed rotation of the particles of ether in the peripheries of ellipses when a pencil of plane polarized light is made to suffer reflections in the interior of glass or at the surfaces of polished metals.

Let, for example, a pencil of light be polarized in some plane by reflection from the surface of glass at the proper polarizing angle; and let it be made to enter an oblique parallelopiped or rhomboid of glass perpendicularly to one of its ends, the inclinations of two opposite sides of the rhomboid to the ends being equal to the polarizing angle: the pencil of light will then suffer two reflections, one from each of two opposite sides of the glass, and it will emerge perpendicularly to the opposite end. Now if the sides of the rhomboid are so disposed that the plane in which the two reflections take place is coincident with or at right angles to the plane in which the pencil of light is polarized, no effect is produced on the pencil; but if the parallelopiped be turned on an axis perpendicular to its two ends till the plane in which the two reflections take place is inclined to the plane of the original polarization in an angle equal to 45°, 135°, 225°, or 315°, the emergent pencil will be found to be circularly polarized. [See CIRCULAR POLARIZATION.] If the inclination of the planes be any other angle than one of these, excluding also the angles 0°, 90°, 180°, 270°, the pencil will be elliptically polarized.

If polarized light, after having suffered two reflections in the glass parallelopiped, be made to suffer two additional reflections in a similar parallelopiped similarly situated, the emergent pencil will be restored to a state of plane polarization; but the new plane of polarization will be perpendicular to the former when the inclination of that plane to the plane of reflection is 45°, 135°, &c.

Sir David Brewster discovered that, when a pencil of plane polarized light is reflected once from the surface of polished metal, it acquires properties similar to those which arise from two reflections of the light within glass. First, only a partial polarization takes place in it when the metal is so disposed that the plane of the incident and reflected pencil is coincident with or perpendicular to the plane in which the pencil was originally polarized. Again, if a pencil of light polarized in any plane be reflected from a plate of polished steel so disposed that the plane of the incident and reflected pencils may be inclined 45°, 135°, 225°, or 315° to the plane of original polarization, the angles of incidence and reflection from the steel being 75°, then that which is called an elliptic polarization takes place. If a second plate of steel be disposed so as to reflect the pencil a second time at an angle of incidence equal to 75°, and the plane in which the two reflections take place be coincident with or perpendicular to one another, the pencil so reflected will be restored to a state of plane polarization, as when it suffered four reflections in passing through two parallelopipeds of glass.

ELLIPTI'CITY, a term used in the theory of the figure of the earth. It means the fraction which the excess of the axis major over the axis minor of an ellipse is of the axis minor itself. Thus if the axis major be 9 and the axis minor 7, the ellipticity is $\frac{2}{7}$. The eccentricity of an ellipse is much more commonly used for comparison than its ellipticity. The two must not be confounded.

ELLIS, REV. WILLIAM, a missionary distinguished chiefly for his labours in the South Sea Islands and Madagascar. He was born in 1794 of humble parentage, and in 1814 his services were accepted by the London Missionary Society. After a year's training under Dr. Pye Smith, he was sent out to the South Seas in January, 1816. Here he spent nearly ten years, and his experience was afterwards embodied in his "Polynesian Researches," a book the more valuable through Mr. Ellis' great love of nature, his botanical and other scientific acquirements, and his descriptive powers. He was subsequently appointed secretary to the London Missionary Society, and in 1853, in his sixtieth year, was despatched on a mission to Madagascar. Mr. Ellis attained there a very high position in the councils of the leading men and of the sovereign, and contributed immensely to the benefit of Madagascar in the crisis of its transition from heathen barbarism to Christian civilization. He died in June, 1872.

ELLO'RA, a decayed town of India, in the Nizam's dominions. Near it are the celebrated Rock Temples, of very great antiquity. The largest cave, Nailasa, is 247 feet long and 150 feet wide. It contains sculptures of almost all the deities of the Hindu mythology. This chamber contains the great temple, which is a monolith, or solid piece of rock hollowed out. It is 103 feet long and 61 feet wide, interior height 18 feet, but its exterior rises in a pyramidal form to the height of more than 100 feet.

ELM (Ulmus) is a genus of plants belonging to the order URTICACEÆ, tribe Ulmeæ. All the species are trees, and some attain a great size and age. The flowers are small and the leaves alternate. In most of the species the flowers appear earlier than the leaves; they are disposed in groups and seated on short peduncles. The perianth is inferior, bell-shaped, with four or five lobes. There are five stamens, attached at the base of the perianth, opposite to the lobes. There are two styles. The fruit is stalked, surrounded with a broad wing. The seed has flat cotyledons. The leaves are serrate. There are sixteen species, natives of the temperate regions of the northern hemisphere, extending in Asia to the tropics along mountain chains. The elm, since the time of the Romans, has been the most commonly cultivated timber tree of Europe. The reason of this is found in its comparatively easy cultivation, the rapidity of its growth, and the readiness with which it flourishes in almost any soil or situation. It also bears transplantation well, and almost at any age. It has, however, its disadvantages; the timber is very apt to shrink or warp, unless it be kept constantly moist, or has been cut down many years before it is used. It is also during its growth very liable to the attacks of insects, which prove destructive to its timber.

Ulmus campestris (the common or small-leaved elm) is a native of the middle and south of Europe, the west of Asia, and Barbary. It is also found abundantly in France, Spain, and Italy. It grows rapidly, and often attains a height of from 70 to 90 feet, with a trunk 4 or 5 feet in diameter, which size it frequently attains within 100 years. The *Ulmus campestris* is still common in Italy. On the Continent generally the elm does not appear to have been cultivated till recent times, although in England it has been so from time immemorial. In its planting and cultivation two objects are held in view, ornament and use. A great recommendation of the elm is its endurance of a smoky atmosphere, and it will thrive in the vicinity of large towns. The noble elms of the parks of London are a living testimony of its value in this respect. Many of the public avenues in France, Holland, and Great Britain are composed entirely of this tree; and its growing in almost every variety of soil, and requiring but little pruning, are, in addition to its ornamental qualities, strong recommendations.

As a timber tree the uses of the elm are very considerable. The wood loses a great deal by drying; a cubic foot weighing 70 lbs. is, according to Loudon, reduced to 48½ lbs. It is of a brownish colour, is hard and fine-grained, withstands well the action of water, and on this account is used for making pumps, water-pipes, &c. It is also used for making the keels of ships. This elm frequently attains a great age. A tree cut down by Sir Hans Sloane, at Chelsea, was said to have been planted by Queen Elizabeth; it measured 13 feet in circumference, and at one time was 110 feet in height.

The common elm does not perfect its seeds in this country, so that it cannot be propagated by seed. In the south of England the usual way is by layers, or suckers, which are thrown out in great numbers by the superficial roots. Layers are said to produce finer trees than suckers.

The bark of *Ulmus campestris* is officinal; it should be collected in spring from branches not too old; the outer bark is removed, and the interior, or *liber*, retained for use. It possesses demulcent, tonic, and astringent properties, and taken in full doses it accelerates the pulse, acting ultimately as a diaphoretic and diuretic.

The recorded varieties of *Ulmus campestris* are numerous. Loudon enumerates eighteen.

Ulmus suberosa (the cork-bark elm) derives its name from the corky nature of its bark, and is supposed by Selby and others to be only a variety of *Ulmus campestris*.

Ulmus major (the greater or Dutch cork-bark elm) is a finer and more graceful-looking tree than the last. It has larger leaves, and the bark is even more corky.

Ulmus effusa (the spreading elm) is a native of Russia, where it attains a great size. The wood is hard and durable, and is used where it grows for all the purposes of the common elm.

Ulmus montana (the mountain, Scotch, or Wych elm) is more abundant in the northern than the southern parts of England, and it becomes more abundant as it approaches Scotland. In that country this tree forms the most prominent object in its picturesque wooded scenery. It is possibly also a native of Ireland. The leaves of the Wych elm are larger than those of the English elm. It is the only truly native elm.

ELMI'NA, a town and fort of Africa, on the Gold Coast, in 5° 4′ 45″ N. lat., 1° 20′ 30″ W. lon., formerly the capital of the Dutch possessions, but with them transferred to England in 1872. It has a population of about 12,000, all coloured. There is a good roadstead, and the houses are well built. Gold dust is found in the rivulets, but not in any quantity. Conceiving that, in the absence of the Dutch, the place belonged rightfully to them, the Ashantees, in 1873, invaded the district to within a short distance of Elmina, and thus caused the war of 1873–74. Elmina is the earliest European settlement on this coast. It was founded by the Portuguese in 1481 under the name of San Jorge da Mina.

EL'MO'S FIRE, ST., the name of a luminous haze which is occasionally seen at the mastheads of vessels. It is produced when the atmosphere is very highly charged with electricity, by the tips of the masts acting as dischargers. In the same way a charged conductor can be discharged by bringing a needle point near it. Travellers in the Alps often see this effect in thunderstorms, the pale blue flame playing harmlessly round the iron tips of their alpenstocks. St. Elmo's fire is, in fact, an intensified case of the ordinary lightning conductor. It is so called from St. Elmo, who was formerly supposed to be the tutelar deity of those who traverse the sea, and of whom this meteoric light was supposed to be the prophetic and visible representation. Sometimes it descends the mast, which is considered as a prognostication of disastrous weather. It was seen by Columbus among the West India Islands, and the crew hailed it as an assurance of their supernatural protector being near.

ÉLOGE, in the French language, means praise, being derived from the Latin *elogium*, and that from the Greek *eulogia*. It has become the name of a considerable branch of French literature, consisting of orations in honour of distinguished deceased persons. It is the custom, for instance, when one of the members of the French academies dies and a new member is appointed in his place, for the new member to deliver a panegyrical oration on the labours and other merits of his predecessor. These éloges are generally printed and published, and although they are mostly written in a florid rhetorical style many of them are really interesting biographies. The Italians have also their academical *elogii*. An excellent collection is the "Elogii degli Uomini Illustri Toscani" (three vols. folio, Firenze, 1766–70).

ELO'HIM, a Hebrew name for God, of uncertain derivation, but which contained the primary ideas of strength and power. It is the plural of Eloah, but carries the singular number in the accompanying verb, and the question why this form of the word should be used in speaking of God has given rise to much controversy. Some scholars regard it as an indication of a state of polytheism from which the monotheistic worship of the Hebrews emerged. The interpretation generally accepted by orthodox commentators is that it was meant to include the fulness of all power, and to present God in the aspect of creator and governor of the physical universe.

The same word (with a plural verb) is also used in the Old Testament to designate the deities of the heathen, angelic beings, and earthly rulers and judges. The fact that in some portions of the Old Testament the name Elohim is used to designate God and that in other portions the name Jehovah is adopted, has given rise to considerable controversy, and forms one of the chief arguments used by those scholars who deny the Mosaic authorship of the PENTATEUCH.

ELONGA'TION, an astronomical term for the angular distance between two heavenly bodies as seen from the earth. Custom has confined it to the case in which both bodies are in the solar system, and one of them is generally the sun. Thus we speak of the *distance* of two fixed stars, and of the *elongation* of Mercury from the sun.

EL'PHINSTONE, WILLIAM, founder of King's College, Aberdeen, was born at Glasgow in 1437. He was educated at the University of Glasgow, where he passed A.M., probably in the twentieth year of his age. Afterwards applying himself to theology he was made priest of St. Michael's, or Kirkmichael, Glasgow, in which place he served four years, and then proceeded to France, where, after three years' study of the law, he was appointed professor of law, first at Paris and then at Orleans. In 1471 he returned to Scotland, passed through several dignities of the church, was employed in an embassy to France, was made bishop of Ross in 1479, and bishop of Aberdeen in 1484. Elphinstone took a distinguished part in the general affairs of his country. He was successively ambassador to Henry VII., lord chancellor, and lord privy seal, which last office he occupied at the time of his death, 25th October, 1514, while negotiations were pending with the court of Rome for his elevation to the primacy of St. Andrews.

Besides a book of canons extracted out of the ancient canons, Elphinstone wrote a history of Scotland, chiefly out of Fordun. He wrote also some lives of Scotch saints; and in the college of Aberdeen are preserved several large folio volumes of his on the canon law. By his solicitation the convent of Grey Friars was founded in 1494, and a papal bull obtained for the erection of a university at Aberdeen.

EL'SASS-LOTHRINGEN. See ALSACE-LORRAINE.

ELSINORE (*Helsingoer*), a seaport town in the Danish island of Zealand, stands at the narrowest part of the sound, 25 miles north from Copenhagen, and has about 9000 inhabitants. On a tongue of land north-east of the town is the fortress of Kronborg, which was for some years the prison of Queen Matilda, sister of George III. of England, and which commands the entrance to the sound, and there is a handsome palace called Marienlyst, with an hospital for seamen, built on an eminence close to it. Elsinore itself is an open town, and has been much improved of late years. It has a harbour which is formed by a wooden pier, and is accessible to ships of small draught; a quarantine establishment, some manufactures of arms, sugar, brandy, &c., and a good foreign trade. The townsmen are also engaged in the fisheries.

Ships passing the sound formerly paid duties to the Danish government at Elsinore, but these imposts were abolished in 1856. The roadstead affords good anchorage.

Elsinore is well known from its being the scene of Shakspeare's noble tragedy of "Hamlet." The principal incidents of the play are founded on fact, but so deeply buried in remote antiquity as to make it difficult to discriminate truth from fable. Saxo-Grammaticus, who flourished in the twelfth century, is the earliest historian of Denmark who relates the adventures of Hamlet. His account is extracted and much altered by Belleforest, a French author, an English translation of whose romance was published under the title of "The Historye of Hamlet," and from this translation Shakspeare formed the groundwork of his play, though with many alterations and additions.

EL'THAM, formerly a market-town, but now included in London, is situated 8 miles from London Bridge by the North Kent line. It is a place of 5048 inhabitants, and deserves notice on account of its remains of a royal palace, built at a very early period, in which Henry III. held Christmas in 1270. Succeeding kings frequently resided in it till the time of Henry VII., when Greenwich Palace was built and that of Eltham was suffered to fall into decay, though Henry VIII. here celebrated the "still Christmas" of 1526, on account of the plague raging in London. The hall was until recently occupied as a barn, is 100 feet long by 56 feet wide, with a carved timber roof, and windows which have been very elegant, but are now mostly bricked up. The area of the palace is surrounded by a wall, and the ditch, which is now dry and planted with shrubs, is crossed by an ancient bridge. There are several churches and Congregational and Wesleyan Methodist chapels, and schools and almshouses. Eltham was formerly called *Alteham*, meaning the old home.

EL'VAN, a term loosely applied by Cornish miners to all fine-grained granitic and felsitic dykes. It is, however, becoming restricted to the so-called *quartz porphyry* or *quartz-felsite* (called also *elvanite*), a rock consisting of an amorphous or micro-crystalline base of quartz and orthoclase, with grains of quartz scattered through. See FELSITE.

EL'VAS, a town in the province of Alemtejo in Portugal, about 125 miles east from Lisbon, is situated on a hill in the midst of an extensive plain. It is a frontier town, and about 12 miles west of Badajoz. Elvas is the strongest fortress in Portugal; it is situated between two castles, Santa Lucia and La Lippe, which stand on two summits commanding the town. It is a bishop's see, and the chief town of the comarca of Elvas. The town contains about 17,000 inhabitants, and has a fine cathedral, and very extensive barracks, which are bomb-proof. A handsome Moorish aqueduct brings water from a distance of about 4 miles.

Elvas was a post of great importance during the Peninsular War. Marshal Junot took possession of it in March, 1808, and held it till it was given up, under the convention of Cintra, in August following. The Duke of Wellington had a powerful telescope placed in the tower of La Lippe during his military operations, by which the interior

of the Castle of Badajoz could be plainly looked into, and all the operations discovered.

E'LY, a city and the see of a bishop, in the county of Cambridge, England, situated on an eminence near the western bank of the Ouse, which is navigable for barges from Lynn, at the mouth of the river. The city is 15 miles north by east from Cambridge, and 72 miles north by east from London by railway. It consists chiefly of one long street, and has a spacious market-place near the centre. Ely was in very early Saxon times the site of a monastery, which, having been destroyed by the Danes, was rebuilt, and in 1109 was erected into a bishopric by Henry I., when the manors belonging to the monastery were divided between the bishop and the monks, who were thenceforward governed by a prior. Henry VIII. by charter converted the conventual church into a cathedral. The most ancient parts of this fine structure were erected in the reigns of William Rufus and Henry I., and the whole was completed about 1340. Its length is 535 feet; transept, 190 feet. The height of the great western tower is 270 feet. The central octagon tower is surmounted by a dome, with a lantern 170 feet high. The interior is very beautiful. [See ENGLISH CATHEDRAL ARCHITECTURE.] Its thorough renovation was completed in 1875 at a cost of considerably over £60,000. The bishop's palace is near the west end of the cathedral. There are two parish churches, one of which is the chapel of St. Mary, attached to the north side of the cathedral. A free grammar-school was founded by Henry VIII., and a handsome new building erected for it in 1881. The population of the city of Ely in 1881 was 8172. Coarse pottery is manufactured, but the trade of the city is chiefly agricultural; the country around is exceedingly fertile, and from the neighbouring market gardens large quantities of vegetables are sent to the London markets. The bishopric of Ely comprises Cambridgeshire, Bedfordshire, Huntingdonshire, and parts of Suffolk, Norfolk, and Essex. Very great improvement has taken place in the sanitary condition of Ely within recent years. The city has been thoroughly drained, and water carried to every house, the result being a very remarkable decrease in the rate of mortality.

Ely derives its name either from the Saxon word *elig*, an eel, or *helig*, a willow, and was founded on that part of the Fen country called the Isle of Ely, which was defended by Thurstan, one of the abbots of Ely, against William the Conqueror for seven years.

E'LY, ISLE OF, a district in the county of Cambridge, forming the northern half of the county, from the southern half of which it is separated by the river Ouse. It was formerly a part of the fen country, but the whole district has been greatly improved by drainage, and its soil is now extremely fertile. The population of the district is about 65,000.

ELYS'IUM, or **ELYS'IAN FIELDS**, the name given by the ancient Greeks and Romans to the abode of the righteous after death. The expression does not occur in Homer as meaning part of the under-world. With him it is a pleasant land on the western shores of Oceanus, that great river which surrounded the world—a happy region where perpetual spring reigned, where never snow nor rain fell, and where balmy breezes kept subdued the fierce rays of the sun. It is with him the place of the blest who have not died, but who have been caught up out of life by special favour of the gods. Hesiod at a later age claimed Elysium for the dead, and placed it as a group of smiling islands in the mid stream of Ocean, the "islands of the blest." By Virgil's time the Elysian fields were merely the abodes of those shades who were not suffering punishment. They were part of Hades, the underworld. We now see the last degradation of the beautiful myth, for the *Champs Elysées* is the name given to a fashionable promenade in Paris. In later Latin times *Elysii Campi* was the term sometimes applied, by way of happy prophecy, to a cemetery. Thus the great *Elysii Campi* of sacred Arles has become its *Aliscamps*, well known to every traveller, to whom, however, the changed name has possibly destroyed the connection of its solemn quiet sadness with the ancient paradise.

EL'ZEVIRS, a celebrated family of printers, whose books (chiefly Latin) are the delight of bibliopoles for the extreme beauty of their typography and binding. There are about 1200 different elzevirs in all, and of these over 950 are in Latin. The name is a corruption of the usual Latin designation of the family *Elzeverius*, their real name being Elzevier (or Elsevier). Louis Elzevier, a bookbinder of Louvain, driven out by religious disturbances, settled at Leyden in 1580; and in 1583 printed and issued his fine *Drusus*. The famous *Eutropius* did not appear till 1592. The five sons of Louis (especially Bonaventura, the most celebrated of the whole family) all followed their father's trade. Bonaventura's books are probably the finest specimens of printing in the world, except only in Greek printing, in which the palm admittedly rests with the ALDINES. Elzevirs are very often small, their favourite sizes being 12mo, 16mo, and 24mo. Their chef-d'œuvre, "Les petites Républiques," is in the latter size. A later generation of the family, however, used folio, adopting it for the splendid *Corpus Juris* (1663). The last of the great Elzeviers (Daniel) died in 1680, but others here and there printed after that date, and Abraham Elzevier was university printer at Leyden as late as 1712.

EMANA'TION (a flowing out of), the name of a philosophical doctrine common to many Oriental nations, but most beautifully set forth by the Neo-Platonists of Alexandria. They held that God's will or intelligence was manifested in the world, not that God is the world (for that is Pantheism), but that in one sense the world was God or a part of God. All the flux of natural things is produced by the ever fresh emanations of force from God; nothing is permanent save types and universals; God is the only existence. A man thoroughly permeated by one of these emanations of divine force enjoys the transcendental ECSTASY OF PLOTINUS, he has glimpses of the permanent divine source of all. God does not grant emanations of power or withhold them at his will, they taught; they are a necessity of his being. As he is a creator, so must he be always creating. The doctrines of emanation current among the Hindus, the Persians, &c., are not widely separate from the above.

EMBALLONU'RIDÆ, a family of BATS (Cheiroptera), differs from the rest of the order except the Phyllostomidæ (Vampire Bats) in having the tail perforating the interfemoral membrane, and usually produced as a free organ beyond it. The muzzle is obliquely truncated, and at its extremity are the nostrils, which are simple and not provided with leaf-like appendages. The first phalanx or joint of the middle finger is folded in repose upon the upper surface of the metacarpal bone. The upper incisor teeth are large in the front of the jaw, and usually two in number. The Emballonuridæ are widely distributed throughout the tropical and subtropical regions of both hemispheres. One species only occurs in Europe. There are sixty-five species known, contained in thirteen genera. Insects constitute the food of all this family. The principal genera are Emballonura, Taphozous, Rhinopoma, Noctilis, Molossus, Mystacina.

EMBALM'ING, the process by which dead bodies are preserved from putrefaction and decay. By the ancient Egyptians this art was carried to great perfection, and those who could afford it preserved in this way the whole of their dead, and also the bodies of cats, crocodiles, ichneumons, and other sacred animals. Various reasons have been suggested to account for the origin of this custom, such as the scarcity of fuel suitable for the process of cremation

and the impossibility of burial during the annual two months' period of the inundation of the Nile, but the most probable explanation is that which connects the custom with the religious beliefs of the Egyptians. They were firm believers in the immortality of the soul, and they looked for its return to a human body after it had completed a cycle of existence in the spirit world.

The time when this practice first came into use is unknown, but it is certainly as old as 2000 B.C.; it probably dates from a much earlier period. Of the Egyptian methods of embalming two minute accounts have come down from antiquity in the writings of Herodotus and Diodorus, but these can only refer to the periods in which these writers lived; though there is a general kind of agreement between them, they differ very much in details, and their accounts have been only partially confirmed by modern examinations of the bodies preserved. According to Herodotus the art was practised by persons regularly trained to the profession, and its secrets were handed down from father to son. In the case of wealthy persons the brain was in part removed through the nostrils by means of bent iron instruments, and the remaining portion was dissolved by the injection of caustic drugs. An incision was made along the flank by means of a stone knife, and the intestines and lungs were removed, the heart and kidneys being left in the body. The interior cavity was then washed with palm wine, and afterwards scoured with pounded perfumes. It was then filled with pounded myrrh, cassia, and other aromatic substances, and the opening sewed up. The body was afterwards steeped in natron for seventy days, then washed and swathed in bandages of linen cut in strips and spread over with gum. It was then placed in a wooden coffin, and this was set upright against the walls of a house or tomb. The cost of this process was a talent of silver, or between £225 and £250.

Another method, which cost twenty-two minæ (£90), consisted in the removal of the brain as in the former process, but instead of the removal of the intestines a quantity of cedar oil was injected into the abdomen through the rectum and the passage closed. The body was then steeped in natron for seventy days, and on the last day the oil was allowed to escape, when it carried away the internal organs in solution. The flesh had also been consumed by the natron, so that only the skin and bones were handed back to the relatives. The process adopted by the poorer classes consisted in washing the intestines with "syrmæa," an infusion of senna and cassia, and in steeping the body for the usual number of days in natron. The cost of this method is unknown, but it was very slight. As this practice was followed for several hundred years it will be easily conceived that many variations of method were adopted at different periods; in some instances the viscera, after being embalmed, were replaced in the body, while in others they were placed in vases for interment near the mummy. Mummies have also been found which appear to have been merely dried in sand, and others which have been placed in molten bitumen, or which have been subjected to a process resembling tanning.

There are two instances of embalming (viz. of Joseph and his father Israel) mentioned in the last chapter of Genesis, but both occur in connection with Egypt, and it does not appear that the art was practised by the Hebrews. The use of spices as a preservative against decay was, however, known by them, and we read in 2 Chron. xvi. 14 that the body of Asa was laid "in the bed which was filled with sweet odours and divers kinds of spices prepared by the apothecaries' art." In the New Testament also there is a reference to this custom in connection with the burial of Jesus, when Nicodemus "brought a mixture of myrrh and aloes, about an hundred pound weight," for this purpose (John xix. 39).

By the Egyptians the practice of embalming continued in use until the time of St. Augustine, who says that the bodies thus treated were called *gabbaræ*; in the hieroglyphs they are termed *sahu*. The art seems never to have been lost altogether, and many eminent surgeons and anatomists of Europe have practised it with success. Dr. William Hunter used essential oils, which he injected through the principal arteries of the body, and he also employed alcohol, camphor, saltpetre, and pitch. Corrosive sublimate, alumina, arsenic, creosote, and carbolic acid have all been used by modern embalmers, but it is doubtful whether bodies preserved by these means would last like the mummies of ancient Egypt. The most successful embalmers of modern times are Italians, members of the surgical profession, but who guard the secrets of this branch of their occupation with jealous care.

EMBANKMENT. The term embankment is used (1) in connection with railway engineering. The embankment is made to carry the line of railway over depressions of the country, and considerable skill is required to prevent slipping and sinking. (2) In connection with the sea and rivers. It is often necessary to raise mounds or dykes along the course of rivers to keep them within their channels, and prevent their flooding the lands which lie near them. Many parts of Holland could not be inhabited if the sea were not kept out by strong embankments; and the destruction of these frequently desolates great tracts of country.

The first thing to be attended to in forming embankments is to enable them to resist the pressure of the highest floods which are likely to occur, and to prevent the effect of the waves and currents in washing them away. When it is the pressure merely of a column of water which is to be withstood, a simple earthen bank made of the soil immediately at hand, provided it be not of a porous nature, is sufficient. Its form should be a very broad base with sloping sides and with a flat top, which may serve as a path or even a carriage road.

When the dykes are only intended to check the waters at the time they flow over their natural banks, it is best to raise them at some distance from the river on each side and parallel to its course; because in sudden floods the water, having a greater space to flow through, will not rise so high, and will sooner recede.

Where embankments are made against the sea greater skill is required to resist the force of the waves. If there are materials at hand to lay a bank of stones imbedded in clay with a broad base, and the sides sloping very gradually upwards, a very safe barrier may be opposed to the waters. It is not the direct impulse which is the most destructive; waves striking against a sloping surface lose their force and rise over it; but it is in returning that they draw the materials with them and scoop out the foundations. In a place where shingles were usually thrown up by the waves and the bottom was a strong clay, their retreat has been intercepted by rows of strong piles driven in a line along and parallel to the shore, and covered with boards nailed to them on the land side. In one night the shingles have been thrown over the piles, and being retained by the boarding have formed a perfect wall. In other cases several rows of piles are driven in, and stones thrown into the spaces between them.

Where the land lies very flat for a considerable distance from the shore, it is of advantage to have two complete banks, one within the other, so that if the outer bank is broken through the second will keep back the waters until the first can be repaired. The water which accumulates within the banks, and is collected in the internal ditch and those which divide the marshes, must be let off occasionally by means of channels and sluices when the tide is out.

EMBAR'GO, the word used to denote the act by which any government lays an arrest on ships to prevent their leaving its ports. On the breaking out of war with any

nation it has been usual for the government of each country to lay an embargo upon such of the enemy's ships as are within reach, with a view to their being declared good and lawful prize. During the progress of war, when any expedition is on foot against the enemy, and it is desirable to keep the circumstance from the knowledge of the party to be attacked, it is usual to lay an embargo upon all private vessels, as well those under the national flag as foreign vessels, until by secrecy the object to be obtained is accomplished. An embargo may also be laid by the government upon ships belonging to its subjects, with a view to their employment for the service and defence of the nation. In all these cases it is clear that embargoes are detrimental to commerce. The only case in which they have an opposite character is when a foreign vessel of war or privateer frequents a neutral port, and is restrained from quitting the same until a certain time shall have elapsed after the departure from the port of any vessel of which it might otherwise make prize. Sometimes an embargo is laid upon certain specified goods only, all other cargoes being allowed free departure or entry.

EM'BASSY. Generally speaking, by the term embassy is meant all kinds of diplomatic missions, including those under the charge of envoys and consuls; but in a strict sense it should be confined to those political agencies alone which are presided over by an *ambassador*, representing for the time being the person of his sovereign, and having the authority to demand a private audience of the monarch to whom he is accredited. There are six such embassies from England, viz.—those in France, Russia, Austria, Germany, Italy, and Turkey. The ambassadors receive salaries varying from £6000 to £10,000 per annum, and an allowance for house-rent. Their secretaries, attachés, and servants are also salaried by the government. The total cost of the six English embassies is about £90,000 per annum, of which sum £60,000 is for salaries and allowances, and the rest for purchasing, hiring, furnishing houses, chapels, and offices, and other incidental expenses. The total cost of all our embassies, missions, and political agencies in foreign countries is about £200,000 per annum.

EMBER DAYS and **WEEKS**, certain times in each season of the year set apart for imploring the blessing of the Almighty on the produce of the earth by prayer and fasting, observed in the Christian church as early as the third century. At first the Ember Days were not uniformly observed by different churches at the same time; but the Council of Placentia, 1095, fixed the spring and summer Ember Days to be the Wednesday, Friday, and Saturday in the Ember week, that is in the week after the first Sunday in Lent and Whitsunday; those of autumn and winter upon the same days after the feast of the Holy Cross or Holyrood Day (14th September) and St. Lucia (13th December). These seasons are also set apart in the Western churches for the ordination of clergy, a custom which can be traced back to the end of the fifth century. The word is from the German *quatember*, a corruption of Latin *quatuor tempora*, four seasons, and has nothing to do with embers or ashes. Some derive it from the Old English *ymb*, round, as if it meant "recurring fasts;" but as *quatuor tempora* was a monkish phrase in use in what are called Anglo-Saxon times, *ymber* would seem to be probably a case of "folk-etymology," making a native word of not distant signification to do duty for a foreign word like it in sound.

EMBEZZLEMENT (formerly *embesil*, from Old French *imbéciller*, to weaken—*i.e.* to weaken a store by repeated filching from it), the fraudulent appropriation by servants and others of money or goods intrusted to their care, or received by them on account of their employers. Three things are essential to the crime of embezzlement—first, that the offender must be a clerk or servant; second, that he must receive into his possession some chattel on behalf of his employer, and that he must fraudulently embezzle the same. If the chattel has passed into the actual or constructive possession of the employer, the offence becomes *larceny*. Thus if a shopman receives money from a customer, and instead of putting it into the till puts it into his pocket and appropriates it, the offence is embezzlement; but if after putting it into the till he takes it out and appropriates it he becomes guilty of larceny. The distinction, however, has but little practical import, for if a prisoner is placed upon trial for embezzlement, and the offence turns out to be larceny, he will not be entitled to acquittal, but he may be found guilty of the larceny, and *vice versâ*. The law on this subject has been regulated and defined by the Larceny Act, 24 & 25 Vict. c. 96. Persons guilty of embezzlement are liable to be kept in penal servitude for any time not exceeding fourteen years.

In the Larceny Act provision is made also for dealing with similar offences on the part of bankers, brokers, attorneys, and other agents, and also of trustees and directors of public companies, while a later Act, 31 & 32 Vict. c. 116, deals with acts of embezzlement committed by any member of a copartnership against his fellow-members.

EM'BLEM, a figurative representation which by vesture of association suggests to the mind something not expressed to the senses; thus a lion is the emblem of courage and a cock of watchfulness, the red rose is the emblem of the house of Lancaster, and the cross is the general emblem of Christianity.

EM'BLEMENTS (from the French words *emblavence de bled*, corn sprung or put above ground) means the profits of land sown; but in its usual sense it extends to roots planted and other annual artificial profits which arise from the soil, as, for example standing corn, hemp, saffron, flax, hops, and garden produce growing above ground, as melons and cucumbers, all of which annually require either sowing, planting, or manuring at the expense of the tenant, and are not a permanent or natural product of the soil.

All persons are entitled to the emblements of land sown by themselves in which they have an uncertain interest. Thus the representatives of a tenant for life who dies previous to harvest are entitled to the growing crops.

The parochial clergy and their under-tenants, being also tenants for life, and their representatives are entitled to emblements by the 28 Henry VIII. c. 11, s. 6. The produce of fruit-trees and grass is not included within the meaning of emblements. The executors of a tenant in fee or in tail are also entitled to the emblements as against the heir or heir in tail, but not as against a doweress or a devisee of tenant in fee, for the devise of the land carries with it the crops.

EM'BLICA, a section of a genus (Phyllanthus) of plants belonging to the order EUPHORBIACEÆ, and consisting of one species, *Phyllanthus Emblica*. This species is a native of most parts of India. The bark of this tree is astringent, and is used in India as a remedy for diarrhœa. The fruit is acid and astringent, and when eaten acts as a mild purgative. The tree yields timber, which is valuable, as it resists damp. This species is distinguished by the stamens being three, anthers erect with parallel cells; and in the female flowers by the ovary being three-celled, with connate styles.

EMBOSS'ING (Fr. *bosse*, a swelling or hump) is the art of producing raised figures upon paper, leather, wood, or other materials, by means of pressure, either applied by a sudden blow, as in a stamping-press, or in a more gradual manner, as by an ordinary screw or hydraulic press, or by revolving cylinders. The pattern is usually produced by forcing the face of the material against an engraved die in which the design is cut; and sometimes, when the article to be embossed is in the form of a thin sheet, a counterpart to the die is applied at the back to aid the process. In many cases heat is employed during

the operation with great effect. Thin plates of metal are embossed by pressure between a pair of steel dies, in one of which the figure is hollow and in the other raised. In recent times the art of embossing has received many beautiful applications.

The embossing press designed and constructed by Mr. Edwin Hill for impressing the medallion upon postage envelopes is a very elaborate and beautiful machine, which inks the die itself, and with the aid of two boys to place and remove the envelopes embosses sixty in a minute. The same machine, or one similar in principle, is applicable to the embossing of paper wafer-medallions. The envelope-embossing apparatus is nationally important, for each stamped envelope becomes at once a species of paper money, exchangeable at many times the actual cost of manufacture. The embossing is on this account conducted at Somerset House, by government officers.

EMBRA'CERY, an attempt to influence or corrupt a jury, or induce them to favour one of the parties in a cause. It is punished by fine and imprisonment. The crime of embracery is completed whether the jury on whom the attempt is made give any verdict or not, or whether the verdict given be true or false.

EMBRA'SURE, in fortification, is an opening made in an epaulement or parapet for the purpose of allowing a gun to be fired through it. Embrasures are usually 2 feet wide at the neck or interior extremity; and at the mouth, or exterior extremity, their width is equal to half the thickness of the epaulement, that is, about 9 feet. The cheeks or sides are frequently formed vertically at the neck, that the men who serve the guns may be covered as much as possible; but beyond that part each side declines gradually from a vertical plane outwards, in order that it may be less injured by the fire of the piece. In permanent fortifications the sides of the embrasures are generally reveted or lined with brickwork; but in field batteries the earth at the sides is either without support, or is kept up about the neck only by gabions or fascines. To some extent embrasures have been superseded by the system of firing guns *en barbette*—that is, over the parapet—the weapon being raised by machinery for firing, and lowered immediately after. By this means the openings into a fortification, which often present tempting marks for an enemy's guns, are avoided.

EMBRASURE, in architecture, is the indent of a BATTLEMENT. It signifies also the splay of a door or window. The term is derived from its use in fortification. Etymologists hesitate whether to consider it arising from the Scandinavian *brasa*, fire (root of brass, brasier, &c.), or from an Old French verb, *braser*, to skew. Probably the latter arises from the necessity of the embrasure being skewed to admit and yet protect the defender, the primary meaning being an opening from which fire or molten metal was poured down on the besiegers from the battlements of a fortress.

EMBROCA'TION, a term employed to denote certain external applications which produce the effect of counter-irritants, and are applied by rubbing.

EMBROID'ERY, a mode of working devices on woven substances. In some examples of this kind a rich effect is produced by inserting slips of parchment cut to suit the devices between the fabric upon which the embroidery is executed and the threads of silk or other material of which the pattern is formed, so that the embroidery may be raised considerably above the surface. Gold and silver thread are often used in embroidery with good effect, and spangles or tinsel are occasionally mixed with the needlework. The fabric to be embroidered is usually stretched in a kind of frame or loom, and the pattern is drawn either upon its surface or upon a piece of paper applied underneath it.

Although embroidery has, until within a few years, been a purely handicraft employment, it has latterly assumed the character of a manufacture, a most ingenious machine for executing it having been brought into use in France, Germany, Switzerland, and England. Attended by one grown person and two children each machine does as much work as fifteen embroiderers. The art of embroidery has revived of late years, chiefly through the increasing requirements of the church for altar-carpets, altar-cloths, and altar-linen. Artists now design, and sisterhoods execute, very beautiful works of art for these purposes.

England was at one time famous throughout Christendom for the richness of her embroidery, and particularly for a new method known in the thirteenth century as *opus Anglicum*. In the South Kensington Museum there is a very fine example of English work of this period, known as the Syon Cope, embroidered in gold, silver, and silks.

EM'BRYO, EMBRYOL'OGY. Embryo, in botany, is the rudimentary plant found in the seed. In the orchids and some other plants it is composed of a few cells, without any evident differentiation into parts. In others, *e.g.* in the violet, the embryo is large, but does not fill up the whole of the interior of the seed, the remaining portion being occupied by a cellular tissue called the *albumen*, in which is stored up starch and other nutritive material for the support of the young plant during germination. In the embryos of most plants two distinct parts can be seen—the rudimentary stem (*caulicle* of Asa Gray, *radicle* of systematic botany) and the cotyledons or seed-leaves. Sometimes the cotyledons absorb during the ripening of the seed the whole of the nutritive substances contained in the surrounding cells, so that the ripe seed contains only the embryo and no albumen; such seeds are called *exalbuminous*. Good examples may be found in the seed of the maple, apple, and also in the bean, in which the cotyledons have become so thick and fleshy as not to be easily recognizable as primitive leaves. In the maple there is no other part than the cotyledons and caulicle, but in the apple and bean there will be found at the apex of the caulicle between the cotyledons a very small bud, which is called the *plumule*. When the seed germinates the nutritive substances pass from the albumen through the cotyledons, or, where there is no albumen, from the cotyledons into the rudimentary stem, and the embryo pushes upwards and downwards, producing leaves on the portion which ascends from between the cotyledons, and developing a root on the part which strikes downwards into the soil.

In the embryos of some plants there are two cotyledons or seed-leaves; in others, as in grasses and palms, there is only one. These differences correspond to others which are very important, but which only appear as the plant develops; they form the basis of the classification of ANGIOSPERMS into dicotyledons and monocotyledons. In systematic botany the radicle is said to be *superior* when it points to the apex of the root, and *inferior* when it is turned to the base.

EMBRYO, in zoology, is the rudimentary animal—that is to say, the animal before it leaves the egg in oviparous animals, or before it leaves the parent in viviparous animals. The word comes from the Greek, and means "that which swells and fills up from within." Animals such as polyps, &c., reproducing their kind by simple fission (splitting off) or gemmation (budding out)—asexual generation—cannot be said ever to assume the embryonic state; for in that case the parent and offspring are identical as to structure, differing only in size. But this method of reproduction applies only to so few and such lowly varieties of organisms that Harvey's famous aphorism may be held roughly to hold good for all animals alike—*Omne vivum ex ovo*, "every living (animal) comes from an egg." It is probably known to all readers that the viviparous animals are in fact produced from an *ovum*, only that this ovum is matured within the parent's body instead of, as in the case of birds, fishes, and other oviparous

animals, without it. As yet it is extremely difficult to pronounce upon the nature of the process of fecundation of the ovum. The female organism produces the ovum, the male organism the fecundating matter which renders the ovum fertile and capable of developing into an embryo. But yet among the bees the eggs develop into drones (males) without impregnation, while the impregnated eggs become females, or, if coarsely fed, neuters; and so also, in exceptional cases, it happens among certain moths. It is known, too, that in the embryo of the chick the earlier stages of division of the germ may take place without impregnation. Further, certain animals (as Salpæ, for instance) which produce their young by sexual generation, are succeeded in the persons of that offspring by a race of different characters, and reproducing itself by asexual generation, as by fission or gemmation. This is "alternate generation." The second race eventually recovers the power of sexual generation, producing an embryo which develops into the original form. That is to say, if grandparents and grandchildren are alike and sexual, the intermediate generations are unlike them and are asexual.

Also the phenomenon of *parthenogenesis* (virginal maternity) presents at once a great difficulty. Here (as in the insects *Coccus hesperidum*, *Chermes abietis*, &c.) only females exist, as far as can yet be known, and yet these lay ova from which other females proceed. Among the Lepidoptera, Psyche and Solenobia give examples of parthenogenesis mingled with those of sexual generation—by the first only females are produced, but where the rarely occurring males have impregnated the ova, the embryos develop into about equal numbers of males and females. Other cases of parthenogenesis occur which produce a male generation exclusively. All these circumstances render it impossible at the present time to say definitely what general phenomenon underlies the development of an ovum into an embryo.

But the course of that development is perfectly well known, and speaking broadly always follows the same lines. These have been traced for vertebrates in the article DEVELOPMENT, and the vertebrate type is only an extension of the invertebrate. The primordial cell which constitutes the germ of a man cannot be in any manner distinguished as to its structure, &c., from that which will make but a lowly zoophyte. The external layer of the yolk, which but protects the vertebrate embryo, becomes the hollow body itself of the polyp. At a further stage of development it presents no structural differences from that of a bird, fish, or any other vertebrate. Still further development yet permits no profound separation among mammalia, and the accurate similarity between the higher apes and man extends over a very considerable part indeed of embryonic life. Yet later is it before external sexual differences appear, the early embryo following rather the male type than the female. Thus it is shown that development is but differentiation of similar into dissimilar parts; and further, that the more closely allied in structure are any two fully grown animals, the later do their embryos remain indistinguishable in the course of their development.

But further, since all organisms reproduce the main peculiarities of their parents, embryology presents us with a key to the development of those parents from more ancient forms. Why should a frog begin by being a fish, breathing by gills, then proceed to become a tailed amphibian, breathing by gills and lungs as well, and finally end as a tailless frog, breathing by lungs only? All evidence goes to show that in this development of the frog the life-history of the frog race is typified. If a fish-like animal developed into a creature with lungs and gills, its embryo would of course have to pass through the fish type, that the course of development might be acted out; if the creature with lungs and gills became an amphibian, the embryo, after its fish period, must pass through the intermediate type before it can cast aside gills and tail entirely. How can it gain its final structure, the result of development along certain lines, without briefly passing over those stages of development which its ancestors slowly, and in many generations, passed through? Thus man's embryo at one period is possessed of a tail, is covered with hair, has tips to its ears, &c., proclaiming to all who are not wilfully blind the miraculous changes through which his destiny has led him.

The fœtal or embryonic life of all reptiles, birds, and mammals alike embraces some very remarkable appendages. These are the following:—

1. The *Amnion*.—This is a sac filled with a clear fluid, in which the embryo floats. The walls of the amnion are formed in this manner:—The embryo at first consists of the notochord, the future vertebral column; above this (dorsally) is to grow the cerebro-spinal nervous system, below it (ventrally) the organs of the body with the sympathetic system. This embryo, lying on the surface of the yolk of the ovum, is gradually tucked in by two crescentic folds of the blastoderm at head and foot, which are followed by similar side folds; and the result is to pinch it off, as it were, from the rest of the yolk, and at the same time to curve its head and foot strongly round. It is not quite pinched off, of course a ventral communication still being kept open to the yolk sac, which is its source of nourishment. At this stage the embryo has been fancifully compared to a canoe turned upside down, the decked parts covered in by the folded blastoderm, the middle open like the "well" of the canoe. In birds the umbilical vessel is the sole source of nourishment, and as it is emptied is gathered up within the body. It will be seen, however, that it is soon superseded in this office in mammals, remaining outside the body and being cast off at birth. It is traceable till the end of the third month in man. The blastoderm, thus gathered in under the embryo, and leaving only the umbilical opening free, at the same time folds back at that free edge; the fold grows in all directions, arching itself up over the embryo till it meets above its back. This fold is the *amnion*. The edge of the amnion is also a fold, and this fold of the amnion (the false amnion) is reflected back all over the inner surface of the ovum. The false amnion and the true amnion eventually meet over the back of the embryo. If a large canvas were fastened round the edges of the well of our canoe, and were drawn up round the boat itself by sides, head, and foot, till it enwrapped the whole canoe, and was fastened together above the central point of the keel, this would very roughly represent the true amnion. If this canvas were so large that after thus fastening it above the keel its free edges might be turned back loosely, and would reach all round the canoe again and meet below and far beyond the well, then this second wrappage would be the false amnion. The space inside the amnion is called the amniotic cavity—the word "embryo" is written within it, in the figure. It gradually becomes larger and larger, being distended with fluid and affording support and protection to the embryo up to the time of birth.

2. The *Allantois*.—In the figure it will be seen that it grows out from the anal end of the embryo, thrusting itself between the true and false amnion. The diagram is taken at this early stage, but afterwards the allantois enlarges and becomes vascular, fulfilling important respiratory and circulatory changes. As the body closes more and more, until the umbilical communication with yolk sac and with allantois becomes a mere cord, part of the allantois gets pinched off within the body and becomes the bladder. Fish and amphibians have no amnion nor allantois. The reason is simple. The embryonic fish swims about, an odd little creature, with the water playing its aerating part freely all round the umbilical vesicle

whence it derives its nutriment. Amphibian embryos inclose the whole vitelline sac within the body, and so require no appendages. Birds, however, depend entirely for their air on the aerating powers of the allantois operating through the porous shell. Mammals soon cease to require the allantois except where it forms the placenta, and its cavity disappears, the walls coalescing with the chorion in the human embryo as early as the end of the first month. It is evidently hardly more than a relic of previous race-development.

3. The *Chorion.*—It is seen in the figure that the false amnion is contiguous to the exterior of the ovum. These unite, and with the addition of an albuminous secretion received by the ovum as it passes down the Fallopian tube to the uterus, form the chorion. The analogue to the chorion in birds is the egg-shell, the rough network of the

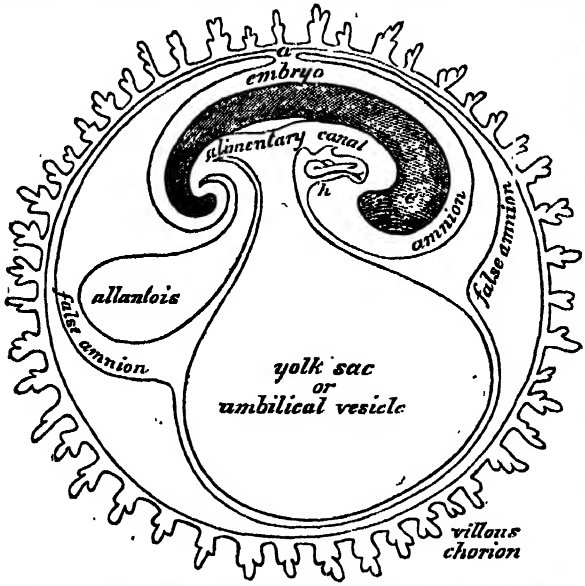


Diagram after Quain of human embryo at fifteenth day—*h*, heart; *e*, head; *a*, junction of amnion and false amnion.

exterior of the ovum being filled with a deposit of carbonate of lime. The chorion in placental mammals becomes rough and shaggy by the thick outgrowth of *villi* upon its surface. Where the allantois first reaches the surface and adds a third layer to the chorion, these villi extend much further and go to form the *placenta.* The allantois having touched the surface extends along it in every direction till it forms a complete inner lining, soon disappearing in man, but permanent in birds' eggs, as said above.

4. The *Placenta* is peculiar to the higher mammals. It is composed of a maternal and a fœtal portion. The walls of the uterus thicken and become highly vascular, while the villi of the chorion, which now gradually cease to exist at other parts of the ovum, push forward at this part into the soft structure. The result is that although there is no absolute continuity between mother and offspring, the fœtal blood and the maternal blood can readily interchange through the walls of the capillaries of the interwoven vessels. The fœtal part of the placenta is, as it were, bathed in the maternal blood. A fœtal vein conveys the maternal blood from the placenta to the heart of the embryo, two fœtal arteries convey the waste embryonic blood to the placenta. The greater part of the placenta comes away at birth (the "after-birth"); the remainder is absorbed.

Circulation.—The fœtal blood is formed by the breaking down of certain branched cells in the mesoblast, and the fluid they yield fills the branching canals thus left open. At the same time the heart appears first as a solid mass, soon becoming vascular, and beginning to pulsate. It is already seen in the figure, though that represents a very early stage. (It must be remembered that we are describing a number of simultaneous developments, not a succession of growths.) In the chick it is seen at the twenty-seventh hour, and is already pulsating (though only a minute red point) on the second day of incubation. The immediate cause of its beginning to pulsate is not yet known. The heart is at first tubular, receiving the two veins (containing arterial maternal blood) and giving off the aorta. Gradually it becomes curved on itself, and in all vertebrates is divided by constrictions into three chambers—auricle, ventricle, and *bulbus arteriosus*—which contract in succession. The ventricle, swelling out at the bend of the curve, soon brings the heart towards the well-known shape, the other chambers drawing near together above it. So the heart remains in fishes. In amphibians the auricle is divided. In reptiles and higher forms the *bulbus arteriosus* disappears, and in birds and mammals the ventricle as well as the auricle is divided, and we have the familiar four-chambered heart. [See CIRCULATION.] The *bulbus arteriosus* also becomes divided in man, and its septum meets the septum of the ventricle; the two tubes it makes are the aorta and the pulmonary artery of later life, which arise one from each ventricle. The blood is propelled from the heart to a series of arches or gill-like structures, which (like the early stage of the heart) remain permanently in fishes as their method of aeration of the blood, but which disappear in the higher vertebrates. It is unnecessary to trace in detail the rapid changes of the circulatory vessels, but the later fœtal circulation of mammals, on account of its great peculiarity, ought to be rapidly sketched. Starting with the blood supplied through the placenta by the mother, we find it first conveyed to the liver, the umbilical *vein* (arterial blood) passing along the umbilical cord down the narrow tube which the swollen amnion has alone left open. The blood here divides, part nourishing the liver, part going straight on, both streams reuniting in the inferior *vena cava* and passing to the right auricle. Here a fold of lining membrane directs it through the *foramen ovale* (closed in the adult) piercing the septum between the auricles, into the left auricle, whence it passes to the left ventricle, and so to the body of the embryo. But at the time that that which we may call the maternal blood entered the right auricle, the blood from the upper part of the body also entered it. The fold of membrane spoken of prevents the two streams mixing, and while the maternal stream crosses the heart to the left auricle the fœtal stream remains on its own side and passes down to its own (right) ventricle. Here it divides; part, as the whole does in the adult circulation, going to the lungs, part, and by far the greater part, to the aorta some way along its course, after the great vessels have left it for the head and shoulders. Thus with the reduced stream of the aorta it passes to the trunk and lower limbs, and what is over flows away by the two umbilical arteries (venous blood) to the placenta, there to be exchanged for fresh maternal arterial blood. Hence the head and upper limbs are supplied with blood nearly pure, but the rest of the body receives a mixed fluid. In a rough way we can say that this is the circulation of reptiles. [See CIRCULATION.] The embryo, once so like a fish, now so like a reptile, has perforce to pass these stages before becoming a warm-blooded mammal. The inference as to the descent of man is irresistible, and far stronger still when one descends to the details. For one instance, the primitive form of the extremities is the same in all verte-

brates whether their destined use is for swimming, flying, or walking. For a time the human fœtus has fingers united by a web. The fore limb always appears first and develops quickest.

EM'DEN, a town of Germany, in Hanover, stands on the eastern shore of Dollart Bay, near the mouth of the Ems, to which it is joined by the Delf Canal. It is surrounded with walls and towers, and consists of Faldern, the old town, and two suburbs. It has all the appearance of a Dutch town, and is intersected by canals, over which there are thirty bridges. Its spacious town-hall, with an old armoury and library, is a noble building. There are six churches, a synagogue, a gymnasium, schools of navigation and design, an orphan asylum, a castle, and customhouse in the town.

Emden is the principal seaport of Hanover, and the trade is carried on chiefly in Hanoverian and Dutch vessels. It has been a free port since 1751, but the Delf Canal, which unites the harbour with the town, can be entered at high water only, and even then it is not navigable for vessels of more than 13 or 14 feet draught. All ships of greater draught are obliged to discharge their cargoes in the fine roadstead called Delf, into which the canal opens. There is a towing canal, about 14 miles in length, between Emden and Aurich. Shipbuilding is carried on to a considerable extent, and the herring fishery is a source of great profit. Emden has brandy distilleries, sawing and oil-crushing mills, manufactures of fustian, cottons, stockings, sailcloth, cordage, needles, leather, soap, tobacco, &c. It has considerable trade in linens, hemp, timber, grain, butter, and cheese. The population in 1880 was 13,667.

EM'ERALD is a transparent bright-green variety of the mineral BERYL, largely used as a gem. It differs from ordinary beryl and aquamarine only in containing a small percentage of chromium, to which it owes its bright-green colour. The Romans obtained their emeralds from Mount Zobara in Egypt, where enormous workings were discovered about fifty years ago; but they appear to have exhausted the locality, at least the crystals now found there are small and poor in quality. Ancient authors mention several cases of articles of large size worked in emerald, but none are preserved. A large emerald dish, said to have been used by our Saviour at the Last Supper, was found among the spoils at the capture of Cæsarea by the crusaders, and assigned as part payment to the republic of Genoa. But when the French took Genoa, during the wars at the beginning of the present century, the dish was tested and found to be green glass. By far the best and largest emeralds come from Muso, 75 miles from Bogota, in New Granada. Their introduction into Europe during the fifteenth century caused a great fall in the price of emeralds, which is given by Cellini, before this influx, as four times the price of diamonds. The finest specimens fell into the hands of the Spanish conquerors of Mexico and Peru, but a large number were unfortunately destroyed. Reginaldo de Pedianza, who accompanied Pizarro's expedition, persuaded the Spanish soldiers that true emeralds would resist a blow of the hammer, and that false ones would not. This wholly unfounded assertion was acted on by the soldiers, who broke many fine emeralds by applying this test, greatly to the advantage of the cunning friar, who thus secured many good-sized pieces from the fragments so produced. Emeralds are also found in the Ural Mountains and in Heubachthal in Salzburg. Like most jewels the emerald had very remarkable properties ascribed to it in ancient and mediæval times. Thus it was believed to be a preventive against epilepsy, a cure for dysentery, and was supposed to guard its owner's chastity, or fly in pieces if that chastity were violated. The *Oriental emerald* of the jewellers is a green sapphire [see CORUNDUM]; it is harder than emerald proper, and commands a higher price. The ancients probably included Oriental emerald, peridote, chrysoberyl, and emerald proper under the head of *emerald*. Good emeralds command a high price, partly from the difficulty of obtaining one of any size free from flaws.

EMER'SION or **EMER'GENCE**, in astronomy, the reappearance of one heavenly body from behind another after an eclipse or occultation.

EM'ERSON, RALPH WALDO, an American essayist and poet, was born at Boston, 25th May, 1803. The son of a Unitarian minister, he was educated at Harvard University, and afterwards joined his father's profession. Its greatest ornament at that period was Dr. Channing—William Ellery Channing—one of the purest and loftiest teachers in that school of religious doctrine, and one of the best English writers of the nineteenth century. Emerson became in 1829 minister of a Unitarian meeting at Boston, but resigned that office in 1832. He visited Europe in the following year, and made the acquaintance of Carlyle, between whose writings and those of Emerson there is often, without any sacrifice of originality, a striking resemblance in the union of mystical speculation with fiery yet homely reproof of the age. Returning to America he settled at Concord, near Boston, and, though preaching occasionally, declined to hold the position of a professional minister of Christianity, choosing instead that of lecturer upon social ethics and literary or biographical topics. In 1836 he gave a series of ten lectures in Boston on "The Nature and Ends of History," which embraced a discussion of all the institutions and interests of society, from what began then to be known as the "transcendental" point of view. The reaction from Puritan dogmas concerning human nature had seemed to be completed by Channing's great theme, "the dignity of man," but here seemed to be a new school teaching the divinity of man. In 1837 Emerson gave the Phi-Beta-Kappa lecture at Harvard University, his subject being "Man Thinking," and this oration, together with a remarkable address to the senior divinity class, won him wide notice for the daring and poetic transcendentalism displayed. The two addresses formed, in fact, the keynote to the sum of his well-known writings, which consist mainly of essays and lectures, ethical, critical, biographical, always didactic, and a few short poems, which had not such wide success as his always poetic prose works. He has been called the poet for poets, but his writings in verse have been always much valued by scientific thinkers. In his "Fragments of Science," Professor Tyndall says:—"The reader of my small contributions to the literature which deals with the overlapping margins of science and theology will have noticed how often I quote Mr. Emerson. I do so mainly because in him we have a poet and a profoundly religious man who is really and entirely undaunted by the discoveries of science—past, present, or prospective. In his case poetry, with the joy of a bacchanal, takes her graver brother science by the hand and cheers him with immortal laughter. By Emerson scientific conceptions are continually transmuted into the finer forms and warmer hues of an ideal world."

The views expressed in the Phi-Beta-Kappa lecture were strongly condemned by the Harvard faculty in divinity on account of their supposed pantheistic spirit. In less than one generation, however, from the year when Emerson was thus condemned as a heretic by the university authorities, he was chosen lecturer in the same institution, and his last important course of lectures was delivered there in 1870 under the general title of "The Natural History of the Intellect." In the meantime his chief productions were "Literary Ethics," an oration, in 1838; "Nature," an essay, in 1839; in 1840, together with Margaret Fuller, he started the *Dial*, a transcendentalist organ; and in 1841 published "The Method of Nature," "Man the Reformer," "Lectures on the Times," and the first collected series of his "Essays." In England these appeared the same year with a preface by Thomas Carlyle. A second series

of "Essays" appeared in 1844, and his "Poems" in 1846. In 1848 he again visited England, where he lectured on "The Mind and Manners of the Nineteenth Century," "Representative Men," &c. In 1856 he published "English Traits," "Conduct of Life" (1860), "Oration on the Death of President Lincoln" (1865), "Mayday and other Pieces" (1867), "Society and Solitude" (1870), "Parnassus," a collection of poems (1871), and "Letters and Social Aims" (1876). These may be said to have been the staple of his life's work, and are the most characteristic examples of his tone of thought and style of expression. It was a doctrine of idealism, akin to that broached in "Sartor Resartus," the outcome of Fichte's and other German philosophy, but cast in a mould of exquisite grace and refinement.

Emerson's works generally cannot be catalogued as belonging to any special school, neither are they a confused assemblage of detached thoughts. He is a thinker in the same sense in which Beethoven was a musician. It is evident, on the first glance, that Emerson seeks to solve the riddle of the universe for himself, and is content with no traditionary answer. Why should not we enjoy, he asks, an original relation to the universe? Embosomed for a season in nature, whose floods of life stream around us and through us, why should we grope among the dry bones of the past, or put the living generation in masquerade out of its faded wardrobe? He insists on man's individuality, and protests against the merging our separate beings into indolent conformity with a majority. Let a man know his worth, and keep things under his feet. Let him not peep, or steal, or skulk up and down with the air of an interloper in the world which exists for him. Beneath opinions, habits, customs he seeks the spirit of the man. The one thing in the world of value is the soul —free, sovereign, active. The history of the world can only be understood as it is lived through in our own spiritual experience. "I can find," writes Emerson, "Greece, Palestine, Italy, Spain, and the Islands—the genius and active principle of each and of all eras—in my own mind." A man must sit at home and not suffer himself to be bullied by kings or emperors, but know that he is greater than all the geography and all the government of the world. Starting from this duty of developing a free individuality, he seeks to be true to himself, let the world say what it will; nay, judging from the treatment given to the great and good, he decides that to be great is to be misunderstood. Believing every man to possess his own greatness, Emerson in his various essays seeks to show the present age its own divinity. True genius will find beauty and holiness in new and necessary facts, in the shop and mill. Proceeding from a religious heart it will raise to a divine use the railroad, the insurance office, our law, our commerce, the galvanic battery, the electric jar, the prism, and the chemist's retort, in which we now seek only an economical use. The end and aim of life is not to assert ourselves, but by individual faithfulness to become fit recipients for the surges of the universal mind, so as to live in thoughts and act with energies which are immortal. The greatest philosopher is but the listener of simplest faithfulness, and the loftiest wisdom is gained when self is forgotten in commune with the universal spirit. Such is, in brief, the general direction taken by the teaching of Emerson. To speak of it as his "philosophy," as was commonly the fashion at one time, is to express a mistaken view of his genius. Emerson's philosophy was not much more than the confusion of an impressionable, highly susceptible mind, and he never pretended to have excogitated a definite system of any kind. The final residuum of his teaching would probably be reducible to a few strong instincts and a few simple rules of good sense; but it is only by a mental illusion on the part of his admirers, similar to that which enables one to discern an articulate voice in the sighing of the wind, that one can find in his glittering and discursive epigrams a connected series of thoughts. He was undoubtedly an essayist of the highest order, with unfailing affinities to all that is best in nature, and his writings leavened American society with elements which a young country always needs. As regards slavery he was early a pronounced abolitionist; and when the nation was in error or wavered as to the merits of the enterprise of John Brown, and, later still, when the southern states' secession called upon each citizen to make his solemn election, his pithy, opportune, unforgetable sayings, passing from mouth to mouth, were decisive for many.

An interesting correspondence passed between Carlyle and Emerson as young men, and when Emerson visited England in 1847 Carlyle was undesisting till he got him down for a day or so at Craigenputtock, his hermitage. Emerson had introduced Carlyle's works into America, and had even sent him some small profits from the booksellers. The two men drifted apart in later years, but always remained great admirers of each other, and never ceased communicating. Their letters were published in London in 1882. ("Emerson—a Biographical Sketch," Alexander Ireland, London, 1883.)

For nearly forty years almost every Englishman of distinction who visited America made a pilgrimage to the "Sage of Concord" in his quiet beautiful home at Brook Farm, embowered in firs and pleasant woods, wherein he loved to saunter with a congenial guest. Here he pursued a simple farmer's life, tending crops and rearing stock, and here, on the 27th April, 1882, he died.

EM'ERY, an impure massive variety of CORUNDUM.

EMET'A, a vegetable alkali obtained from ipecacuanha root, in which the powers of that medicine reside. It is white, pulverulent, and uncrystallizable; its taste is rather bitter, and it melts at 104° Fahr. In the dose of half a grain it acts as a powerful emetic, and in larger doses its effects are extremely violent.

EMET'ICS (Gr. *emética*) are substances which influence the stomach in a peculiar manner, so as to invert its action and cause vomiting; and this effect is produced without reference to the quantity of matter introduced into that organ or into the circulation. The action of emetics must be viewed in two stages—the primary and secondary. The primary effects of emetics are limited to the emptying of the stomach, compressing during the act of vomiting the gall-bladder and pancreas, and exciting to contraction the muscular parietes of the abdomen and thorax, as the machinery by which the process of vomiting is chiefly accomplished.

Soon after a quantity of an emetic substance or solution (such as ipecacuanha or emetic tartar) has been received into the stomach a feeling of anxiety is experienced in the epigastrium, a general uneasiness termed nausea is felt, which progressively becomes greater till it ends in the forcible expulsion of the contents of the stomach. In the preliminary stage the countenance is pale and collapsed; the pulse is small, contracted, irregular, but quick more generally than slow; chilliness is felt, and a cold perspiration may ooze from the surface—all which symptoms disappear when the expulsive movement takes place.

When emetics are given in a smaller quantity, and repeated at intervals, they merely create a state of nausea, during which the appetite is lowered and arterial action is much diminished, while the function of absorption is roused to great activity. The secondary effects of emetics depend upon the succussion of the frame, the equalization of the circulation, the increased secretion from the mucous membrane of the stomach, and also of the duodenum as well as the liver and pancreas, and frequently from the skin. The secondary effects of nauseating doses are diminished arterial action and augmented absorption.

Emetics are useful in cases where the food is causing

irritation and is not being properly digested, as in cases of indigestion and sick headache. They may render great assistance in cases of biliousness, fever, and ague, as the act of vomiting tends to partially empty the gall-bladder and expel bile from the system. In intermittent fevers, if given before the paroxysm, they early bring on the sweating stage, and thus concentrate the fit into a short period. At one time they were greatly relied on in the early stages of acute diseases, and though less popular in this respect than formerly there is considerable evidence in favour of their power to cut short, or at any rate to ameliorate, the symptoms attendant upon continued fevers. In cases of croup or diphtheria the administration of an emetic often serves to bring about the expulsion of the false membrane, and in bronchitis and phthisis to remove accumulated mucus from the air passages. Lastly, in cases of poisoning the prompt administration of an emetic is generally the first step necessary to save life, and one that will act quickly should if possible be selected. In cases of poisoning the sulphate of zinc or sulphate of copper may be used to produce prompt and violent sickness, or a powerful emetic may be made by stirring mustard into water. Other agents used as emetics are—large draughts of tepid water, common salt in water, alum, camomile, ipecacuanha, carbonate of ammonia, squill, tartar emetic, and apomorphia.

Emetics should not be used where there is a disposition to apoplexy or tendency of blood to the head, or where the patient is liable to hemorrhage from any organ, or is subject to hernia. They are also to be avoided during pregnancy.

EM'ETINE, the active principle of ipecacuanha root (*Cephaëlis ipecacuanha*). It is extracted by alcohol. Emetine is a yellowish-white pulverulent alkaloid, of which the root contains about 1 per cent. It is little soluble in water, but very soluble in alcohol. It forms uncrystallizable salts with most of the acids, and is very alkaline. It fuses at 50° C. (122° Fahr.) It is inodorous and tasteless. The formula is $C_{35}H_{25}O_9N$. It is used in medicine as a powerful emetic, and is also expectorant, diaphoretic, and sedative.

EMEU. See Emu.

EMIGRATION may be defined to be a man's leaving his native country with all his property to settle permanently in another. By the term emigrant we generally understand one who leaves an old and thickly peopled country to settle in one where there is abundance of land that has never been cultivated before, and where the native population is thinly scattered, and the foreign settlers are yet either few compared with the surface or none at all. The countries to which emigration is mainly directed at present are the British possessions in North America, the United States of North America, Australia, New Zealand, the Cape of Good Hope, and Natal.

It was long a prevalent notion that emigration should be discouraged or prevented, as tending to weaken a nation. The abstraction of capital, skill, and industry might seem, and indeed is primarily, so much good taken from the mother country; but inasmuch as the emigrants retain in their new settlements, through the medium of commercial exchange, which is daily becoming more rapid and easy, a connection with the parent state, it may be and often is the fact, that they ultimately contribute more to the wealth of the mother country when in the new settlements than they could have done at home.

When these facts came to be more generally understood and appreciated, the business of regulating emigration was undertaken to some extent by the government. First, an agent-general for emigration was appointed. This officer introduced many judicious plans for rendering the passage of emigrants across the ocean as free as possible from discomfort, and a code of rules was framed to secure this and other objects. His duties were after a time transferred to the Emigration Commissioners, and emigrants are now protected by the Passengers Acts. The Act 5 & 6 Will. IV. c. 5, passed in 1835, having proved insufficient for the purpose, a new Act was passed in 1842, and still more stringent ones in 1855 and 1868. Their objects are to regulate the number of passengers in each ship, and to provide for their proper accommodation on board; to insure a proper supply of provisions and water for their use; to provide for the seaworthiness of the vessels; and to protect emigrants from the numerous frauds to which at various stages of their undertaking their helplessness and inexperience expose them. If the ship does not sail on the day mentioned in the agreement, the Passengers' Acts compel the captain to victual the emigrants just the same as if the voyage had commenced; and they must not be set down at the wrong place.

As a further protection to emigrants, and to insure the enforcement of the provisions of the Passengers Acts, government emigration officers are appointed for the ports of London, Liverpool, Glasgow, Queenstown, and Londonderry. These officers act under the immediate directions of the Board of Trade. They procure and give gratuitously information as to the sailing of ships and means of accommodation for emigrants; and whenever applied to for that purpose, they see that all agreements between shipowners, agents, or masters and intending emigrants are duly performed. They also see that the provisions of the Passengers Acts are strictly complied with, viz. that passenger vessels are seaworthy, that they have on board a sufficient supply of provisions, water, medicines, &c., and that they sail with proper punctuality. They attend personally at their offices on every week-day, and afford gratuitously all the assistance in their power to protect intending emigrants against fraud and imposition, and to obtain redress where oppression or injury has been practised on them.

In many of the colonies there are government immigration agents. The duties of these officers are to afford gratuitously to immigrants every assistance in their power, by way of advice or information as to the districts where employment can be obtained most readily and upon the most advantageous terms, and also as to the best modes of reaching such districts.

There are no funds at the disposal of the home government for granting passages to any of the colonies, though Parliament has, in very exceptional instances, voted sums for the purpose. In times of great distress, as in 1882, assistance has thus been given to the emigration of numerous families from Ireland to the colonies. The Poor Law Act of 1834, and other subsequent Acts, empower the application of the poor rate towards the emigration of poor persons, and enable guardians of unions and of parishes to promote emigration at the cost of their funds, with the consent and subject to the regulations of the Local Government Board.

There is, however, a growing antipathy on the part of authorities abroad to the reception of immigrants who have no definite means or ability of making a livelihood. Canada has already enabled the governor to prohibit the landing of paupers till the necessary funds for their temporary support have been provided. The United States have declared that a master of a ship introducing a "public pauper" shall be obliged to take him back free. Nor is this surprising. Considering the almost portentous growth of the great cities of the New World, it is natural enough that they should object to swelling the already considerable mass of poverty with ready-made pauperism from the United Kingdom. The sweepings of a workhouse would probably be beggars in America as they are beggars at home, and the Americans do not care to take them off our hands. Nor is there more room for such a doubtful class of emigrants in the English colonies. A new settlement requires above all things industry and thrift, which are just the qualities least to be found in this class of emigrants.

Emigration is governed by the ordinary laws of supply and demand. In England, a country of circumscribed area, the regular annual emigration is consequently traceable to the great increase of population, and to the want of a corresponding increase in the means of obtaining a living. Exceptional emigration, such as that which existed during 1847 and the six following years, and again in 1863 and 1872, is simply the result of persons searching for cheapness or employment according to the tide of human necessities. To such causes we are indebted to the introduction into this country, during the reign of Edward III., of weavers and manufacturers of woollen cloths from Flanders, as also to the immigration to this country of upwards of 50,000 French after the revocation of the Edict of Nantes.

Down to 1867 the Irish contributed more than half of the total emigration from the United Kingdom, England about one-third, and Scotland one-eighth or one-tenth. But in recent years these proportions have varied. In 1883 the English emigrants were 58 per cent., the Irish 30 per cent., while the Scotch was only 12 per cent. English and Scotch emigrants are less likely to be permanently absorbed in the society of the new countries to which they make their way than the Irish peasant. It is found that the English colonist in a great many cases returns to England when he has made his money abroad, which the Irish peasant rarely thinks of doing.

In 1875 some interesting replies were returned by the French chambers of commerce to a circular from the minister, requesting their advice as to the best means of developing the foreign trade of the country. In the opinion of the great majority of the chambers, the compulsory division of property on the death of the parent is responsible for the comparative failure of French colonization during the present century, for the want of enterprise displayed by Frenchmen in travel and exploration, and for the backward state of the foreign commerce of the country. Comparing France with England and Germany, they asked why, with her superior natural advantages of all kinds, she should occupy so inferior a commercial position abroad! Climate, soil, the poverty of families, and the insufficiency of the means of subsistence offered at home, perhaps also the German military laws, supplied, they said, part of the answer. But after all only a part. The greater number of the chambers were of opinion that the commercial preeminence of England is in no small degree due to the freedom of bequest, coupled with the custom of primogeniture. The freedom of bequest hinders children from reckoning with confidence on their father's property, and the custom of primogeniture compels younger sons to look from early youth to their own exertions as the means of keeping themselves on an equality with the elder. It was pointed out that, previous to 1789, members of some of the noblest families in France consented to expatriate themselves, whereas now emigration has almost ceased; and it was contended that the law of primogeniture promoted thrifty and saving habits, since parents have to provide out of their savings for the children who are not to share in the landed inheritance.

The annexed table gives the most interesting particulars with respect to emigration from 1815 to 1888. It must not, however, be supposed that the "total" figures represent a net loss of population from the United Kingdom to the extent indicated every year. From these totals must be abstracted a considerable number of foreigners, who merely pass through the British ports on their way to America or Australia. Setting these aside in 1883, for instance, we find the entire British emigration in that year was 320,118. Moreover, there is the immigration to set against the latter figures. This amounted in 1883 to 73,804, leaving the loss of population from emigration at 246,314. By immigration we mean, almost exclusively, the return of former emigrants to these kingdoms. In the ten years ending with 1860 the average annual immigration was about 13,000; in the ten years ending with 1870 it was about 31,000; while in the ten years ending with 1880 it averaged nearly 85,000.

Years.	North American Colonies.	United States.	Australian Colonies and New Zealand.	All other Places.	Total.
1815	680	1,209		192	2,081
1816	3,370	9,022		118	12,510
1817	9,797	10,280		557	20,634
1818	15,136	12,429		222	27,787
1819	23,534	10,674		579	34,787
1820	17,921	6,745		1,063	
1821	12,955	4,958		384	
1822	16,013	4,137		279	20,429
1823	11,355	5,032		163	16,550
1824	8,774	5,152		99	14,025
1825	8,741	5,551	485	114	14,891
1826	12,818	7,063	903	116	20,900
1827	12,648	14,526	715	114	28,003
1828	12,084	12,817	1,056	135	26,092
1829	13,307	15,678	2,016	197	31,198
1830	30,574	24,887	1,242	204	56,907
1831	58,067	23,418	1,561	114	83,160
1832	66,339	32,872	3,733	196	103,140
1833	28,808	29,109	4,093	517	62,527
1834	40,060	33,074	2,800	288	76,222
1835	15,573	26,720	1,860	325	44,478
1836	34,226	37,774	3,124	293	75,417
1837	29,884	36,770	5,054	326	72,034
1838	4,577	14,332	14,021	292	33,222
1839	12,658	33,536	15,786	227	62,207
1840	32,293	40,642	15,850	1,958	90,743
1841	38,164	45,017	32,625	2,786	118,592
1842	54,123	63,852	8,534	1,835	128,344
1843	23,518	28,335	3,478	1,881	57,212
1844	22,924	43,660	2,229	1,873	70,686
1845	31,803	58,538	830	2,330	93,501
1846	43,439	82,239	2,347	1,826	129,851
1847	109,680	142,154	4,949	1,487	258,270
1848	31,065	188,233	23,904	4,887	248,089
1849	41,367	219,450	32,191	6,490	299,498
1850	32,961	223,078	16,037	8,773	280,849
1851	42,605	267,357	21,532	4,472	335,966
1852	32,873	244,261	87,881	3,749	368,764
1853	34,522	230,885	61,401	3,129	329,937
1854	43,761	193,065	83,237	3,366	
1855	17,966	103,414	52,309	3,118	176,807
1856	16,378	111,837	44,584	3,755	176,554
1857	21,001	126,905	61,248	3,721	212,875
1858	9,704	59,716	39,295	5,257	113,972
1859	6,689	70,303	31,013	12,427	120,432
1860	9,786	87,500	24,302	6,881	128,469
1861	12,707	49,764	23,738	5,561	91,770
1862	15,522	58,706	41,843	5,143	121,214
1863	18,083	146,813	53,054	5,808	223,758
1864	12,721	147,813	40,942	8,195	208,900
1865	17,211	147,258	37,283	8,046	209,801
1866	13,255	161,000	24,097	6,530	204,882
1867	15,503	159,275	14,466	6,709	195,953
1868	21,062	155,532	12,809	6,922	196,325
1869	33,891	203,001	14,901	6,234	258,027
1870	35,295	196,075	17,065	8,505	256,940
1871	32,671	198,843	12,227	8,694	252,435
1872	32,205	233,747	15,876	13,385	295,213
1873	37,208	233,073	26,428	13,903	310,612
1874	25,450	148,161	53,958	13,445	241,014
1875	17,378	105,046	35,525	15,860	173,809
1876	12,327	75,533	33,191	17,171	138,222
1877	9,289	64,027	31,071	15,584	119,971
1878	13,836	81,557	37,214	15,056	147,663
1879	22,509	134,590	42,178	17,886	217,163
1880	29,340	257,274		20,242	332,294
1881	34,561	307,973	24,093	25,887	392,514
1882	53,475	295,539	38,604	25,670	413,288
1883	53,566	252,226	73,017	18,348	397,157
1884	37,043	203,519	45,944	17,395	303,901
1885	22,928	184.470	40,689	16,298	264,385
1886	30,109	238,453	44,082	18,244	330,886
Total,	1,767,630				

* The customs returns do not record any emigration to Australia during these ten years, but it appears from other sources that there went out in 1821, 320; in 1822, 875; in 1823, 523; in 1824, 780; and in 1825, 458 persons.

The native origin of the emigrants in 1886 was 146,459 English, 25,363 Scotch, 61,297 Irish, and 58,783 foreigners.

It has been objected that in permitting our skilled artisans to emigrate to other countries we are preparing the way for future industrial rivalry. This may be true to a slight extent, but no country can excel in those industries for which it is not primarily fitted by climate and natural resources; and in like manner, where these are favourable, nothing can prevent the successful development of such industries. The wholesale immigration of French silk and velvet weavers to this country in consequence of the revocation of the Edict of Nantes caused the silk and velvet manufacture to become strongly established here, but it has never enabled us to compete with the continental manufacturers. Lyons still retains its supremacy over Spitalfields, and Macclesfield finds its silk manufactures hopelessly dependent on the assistance of Italy.

The only other European country, besides the United Kingdom, from which emigration takes place on a large scale is Germany, from which thousands proceed annually to the United States.

ÉMIGRÉS is the name given to the self-exiled aristocracy of France and their followers, who fled before the first wrathful mutterings of the French Revolution. The emigration began with many princes of the blood and the highest noblesse, the king approving their desertion—as was fit in a society so rotten. They abandoned their posts in July, 1789, on the fall of the Bastille. Yet more cowards fled in the "second emigration;" noblesse, clergy, Commons-deputies, in October, 1789, when the king had been brought to Paris from Versailles after the Insurrection of Women. To Switzerland alone 60,000 fled at this time. What wonder if France succumbed to the Terror, when the heads of the party which should have been the party of order had fled for their wretched lives? Nothing proves the necessity of the Revolution, and almost justifies its horrors, so much as this matter of the emigration. At the close of 1790 the chief military officers had all left, most of them flying across the Rhine, perhaps, one might charitably infer, with a view to leading a forlorn hope from thence; and with them went the great seigneurs, till but a few castles in France knew their owners within their walls. Shamefullest desertion ever known! The king's aunts (Louis XV.'s daughters), though stopped at the frontier, were allowed by the Assembly to pass the Rhine in February, 1791, and at this signal a wholesale departure to all neighbouring lands of all steady old-fashioned people set in. Few will be found to blame these last, abandoned as they were—the king himself attempting to fly on 21st June, and only detained by force. Who that loved the old ways would stay in such a land? Most of these unhappy fugitives were unable to save any of their property. The king's brothers, and all the princes of the blood except Égalité d'Orleans, were now at Coblenz, promoting emigration, collecting men and money from the enemies of France, till at the close of 1791 about 20,000 soldiers were ready for war. There the princes held a sort of court, one of their principal duties being to register the arrival of the faithful, with the purpose of allotting the future spoil of their triumphant re-entry; he who came first deserving, as was just, to be more handsomely rewarded than he who lingered in France to the last.

In September, 1792, the Duke of Brunswick, the King of Prussia, the émigrés (as many as could get arms), and 60,000 soldiers invaded France and took Verdun, but were promptly driven back by General Dumouriez and the republican army at the "cannonade" of Valmy.

The Legislative Assembly, first and last under the new constitution, on 28th October, 1792, sought, or pretended to seek, to end this exhausting tide of emigration, and invited Monsieur, the king's brother, to return within two months—to which Monsieur retorted by a proclamation in the foreign journals summoning the deputies to "return to common sense within two months." On 9th November, 1792, all émigrés were declared suspect of conspiracy, outlawed, and their property confiscated if they were still out of the country after New-year's Day 1793. This summons being, of course, disregarded, decree of outlawry and confiscation was accordingly then passed upon 30,000 émigrés by name. Penalty of death awaited anyone communicating with any of these exiles. Sales of "emigrant-national property" furnished scanty funds for the revolutionary armies. See ASSIGNATS.

Napoleon when first consul issued a decree of amnesty, of which many émigrés availed themselves, and in great poverty and wretchedness returned to their country. Men of the highest birth had taught in schools, had given music lessons, fencing lessons, dancing lessons, for a bare subsistence in other countries. The greater part preferred this misery to the uncertainty of the consulate and the empire. At the Bourbon restoration all returned; many of these recovered their estates, and all were as far as possible rewarded by Louis XVIII. for their fidelity. In 1825 Villèle's motion granted the dispossessed ones compensation for the loss of their estates in the form of interest at 3 per cent. upon the computed value. On the accession of Louis Philippe, and the foundation of constitutional monarchy, this law was abrogated. (See St. Gervais' "Histoire des Émigrés," three vols., Paris, 1823; Viel-Castel, "Histoire de la Restauration," twenty vols., Paris, 1878.)

EM'INENCE, a title assumed by the cardinals of the Roman Catholic Church. Before the pontificate of Urban VIII. they had been styled "most illustrious" and "most reverend."

E'MIR, an Arabic term used in Asia, Northern Africa, and throughout the Turkish dominions as a title of dignity denoting ruler or lord. In former times it was adopted by the Mohammedan leaders in war, and also by their chief ruling families, while the title of *Emir ab Mumenin*, or prince of the faithful, was assumed by the caliphs themselves. It is now given to viziers and pashas, to all independent chieftains, and to all the descendants of Mohammed through his daughter Fatima. The latter enjoy the exclusive right to wear a turban of a green colour, but they have no special rank or position in society, and many of them are poor labourers or even beggars.

EMMAN'UEL COLLEGE, Cambridge, was founded in 1584 by Sir Walter Mildmay, chancellor of the exchequer and privy councillor in the reign of Queen Elizabeth. The number of foundation fellowships is thirteen, which are open to all her Majesty's subjects being members of the Church of England, and a person becomes eligible to them on proceeding to the degree of B.A., or any equivalent degree. There must always be four fellows in priests' orders, and with the exception of fellows holding one of the offices of assistant tutor or bursar, all are required to be in priests' orders within seven years from the day of their election, or to vacate their fellowships at the end of ten years from the same date. Fellows now elected are subject to the provisions of any new statutes made by the University of Cambridge commissioners and approved by the queen in council. There are three scholarships of Sir Wolstan Dixie's foundation, of £30 per annum each, tenable for three years, with preference to candidates educated at Market Bosworth School. Altogether there are about 400 members' names on the college boards. There are twenty-three benefices in the patronage of the college.

Emmanuel College is situated at the south-east side of the town, and consists of a front next the street, which has a central Ionic portico, beneath which is the entrance to the principal court, 128 feet by 107 feet, consisting of cloisters and gallery, hall, combination room, master's lodge, and chapel.

EMMEN'AGOGUES, in medicine, are agents which are used to bring on for the first time, to stimulate, or to restore the function of menstruation. Those most commonly used are such as act *indirectly*, exerting their influence through the system generally, or by means of the irritation of the parts adjacent to the uterus. The drugs chiefly relied on for this purpose are tonics and stimulants combined with purgatives, a combination of myrrh, aloes, and iron being most generally employed. Other remedies of the same character are found in the local use of warm hip baths, leeches, mustard stupes, &c.

EM'MET, ROBERT, was born in Dublin in 1778. He was an accomplished and enthusiastic Irishman, who, having headed a rebellion which proved futile, was tried for high treason, condemned, and executed in Dublin on 20th September, 1803. He would scarcely be remembered but for a speech, remarkable for its eloquence, in which he defended himself at his trial; for his patriotism, which even those who condemned him acknowledged; for his youth, which caused him to be universally commiserated; and for certain touching references to him in the "Irish Melodies" of Moore. The melody "O breathe not his name" has reference to Emmet; and another, "She is far from the land where her young hero sleeps," to a daughter of Curran, to whom Emmet was engaged to be married.

EMOL'LIENTS, in medicine, are remedies which are applied locally to soothe the part and diminish irritation. The principal emollient applications are warm water, steam, warm poultices, oily and fatty substances, and those which form a kind of false skin, such as white of egg, gelatine, collodion, &c.

EMOTION is the secondary or derived part of the great branch of feeling which forms one of the three fundamental departments of mind, namely—feeling, will, and intellect. Feeling is divided into sensation and emotion, and of these the second is derived from the first. Sensation being admitted as the ultimate fact of mind and source of all knowledge (tendencies alone—not knowledge—being inherited), a number of sensations must evidently cause one of two new purely mental sensations, namely that of harmony or that of conflict; the first a source of pleasure, the second of pain. Further, things not immediately pleasurable or painful may by the law of CONTIGUITY become so by transference to them of feelings elsewhere aroused, as in the sympathetic side of emotion, where pains and pleasures of our fellows are felt almost as if they were our own. Again, many varied emotions may combine to form a great whole, as in the moral sense, the æsthetic sense, the love of justice, &c.

Following Bain's division of emotion we classify it thus, proceeding from simple to complex:—(1) Novelty, Surprise, and Wonder are among the simplest of emotional states. (2) Liberty after restraint, Power after weakness, are simple pleasures of that relativity which underlies the greater part of our pleasures if they are closely examined. Eating is the pleasure of a hungry man, and Warmth that of a cold man, &c. These are closely akin to Novelty and Surprise.

(3) Terror is a simple emotion of massive pain, and (4) Love, or the tender emotion, not quite so simple an emotion of pleasure. From Love come Sympathy and Benevolence, Admiration, Reverence, and Esteem; while on another side Self-complacency, and the cognate Love of Approbation, Glory, and the like, arise from the same tender emotion.

(5) Power is a distinct source of pleasure from glory, not necessarily implying the knowledge of others at all; and its correlative pain is Impotence. (6) Anger is the pleasurable emotion of malevolence. Arising itself in pain it manifests itself by an uncontrollable desire to inflict pain on some one else.

(7) The intellectual pleasures of Plot-interest and Pursuit, of the detection of Similarity, as in a fine chain of reasoning (with the correlative pain of Inconsistency), are great and pure sources of high emotion.

(8) The sense of Beauty, or the æsthetic sense, gives rise to all the many varieties of fine art, and is another source of the purest pleasure we can know. But it is manifest that the keener the pleasure in beauty the keener the pain in ugliness. In fact every emotion has its counterpart.

(9) Finally, the most complex emotion of all is CONSCIENCE, or the moral sense, elsewhere dealt with in some considerable detail. Indeed, most of the emotions are more fully considered under their separate headings.

EMPAN'NEL, to write in a roll the names of such jurors as the sheriff returns to try any case. See JURY.

EMPED'OCLES, one of the loftiest of the early philosophers of Greece, was born at Agrigentum in Sicily B.C. 444, of a wealthy and illustrious family, the town being at that time second only to Syracuse in splendour. He was generous and liberal to a fault, giving away the bulk of his fortune in dowries to young girls and in starting youths on a career. He travelled much, and was reputed to be learned in the wonders of the Egyptian *magi*. Men rightly or wrongly believed him to have supernatural powers over the elements, over diseases, and the life of men. He was reverenced almost as a god at the great Greek Olympic festivals, and seems to have accepted this superlative incense. On the other hand he declined quietly but firmly the several appeals made to him to rule over Agrigentum. He would not become a despot; on the contrary, he aided in founding a democratic government in the state and in expelling the oligarchy. He held Pythagorean doctrines, but his immediate teacher was Anaxagoras, an old man at the time. With the Eleatics Empedocles refused to trust to the easily deceived senses, setting the calm exercise of reason far above them. God, he taught, was a purely spiritual being—

> "With rapid and far-flying thought upheld is the whole world by God."

He insisted firmly on the permanence and indestructibility of matter. Nought destroyed, nought created; all is but changed and rearranged. In his usual hexameters he sings—

> "Birth and death do we talk of? shortsighted ignorant mortals!
> The elements part and we die; they mingle afresh, we are born."

These primary elements Empedocles asserted were four in number, earth, air, fire, and water—moving towards each other by the agency of love or harmony, or dissociated by hate and discord. The four elements served the world for centuries after centuries, and do manful service yet; so great is the power of the insight of a great generalization.

Myths clustered round the name of this extraordinary man, and it was universally held in antiquity that having ascended Ætna he never reappeared. Some alleged that he had been snatched away from earth by the gods; others, who found his sandal thrown up at the edge of the crater, averred that he had cast himself into the boiling fire of the volcano in order, added his enemies, to gain credit for a miraculous disappearance. If so the returned sandal betrayed him. The explanation of a simple accident ending in death suggests itself. But more probably the whole is a fiction, since it jars strangely with all we know of the haughty high-strung nature of the poet-philosopher. Considerable fragments only of his hexameters are left. The poems were the admiration of the ancients; and the great Lucretius modelled his style upon Empedocles, whom he reverenced to enthusiasm.

EMPEROR (from the Latin *imperator*). Among the early Romans the title of imperator was bestowed by the acclamations of his soldiers in the camp on a commander-in-chief who had signalized himself by a victory. But

the word imperator was properly applied to him who had what the Romans called *imperium*, or full military power, including that of life and death. The name used by the Greek historians of Rome to express imperator is *autocrator*, one who has full power, from which is derived the word *autocrat*, which is sometimes applied to the Emperor of Russia. C. Julius Cæsar assumed the name imperator as a prænomen or title (Imperator C. Julius Cæsar), a practice which was followed by his successors, as we may observe on their coins. After the time of the Antonines the term imperator seems gradually to have grown into common use as one of the titles which expressed the sovereign of the Roman world, though the name Princeps Senatus (head of the senate), whence our word prince, was also long used as indicating the same rank and power. The Roman Empire was almost a necessity. The constitution of the republic, admirably adapted for a small state, broke down when applied to the government of the world. At that time federation was unthought of, and the anomaly was presented of a scheme of municipal government, with city prætors, censors, public assemblies of citizens, &c., serving for imperial ends. The empire came as a relief to so unnatural a state of things. It was no surprise: Gracchus, Cinna, Sulla, Pompey were all steps towards Julius Cæsar. The distinctive feature of the ancient monarchy was the existence of a despotism upon a republican groundwork. The empire did not annul one of the ancient institutions. Senate, assembly, magistrates of all kinds existed as before, but certain powers were intrusted, as it were by a perpetual delegation, to one man who, without any special title of king or the like, really held all the reins of power in his hands. The emperor was commander-in-chief, held the imperium, the tribunician power of veto over all laws, was prince (chief of the senate), was high pontiff, was either consul for the year if he submitted to election, or was clothed with consular power if it was not his pleasure to take the formal office. All these powers were conferred on each of the emperors of the earlier centuries by special votes, and those often not for life. Augustus never took any powers for more than five or ten years at a time. If, for instance, in France the president of the republic were also to be the perpetual prime minister, commander-in-chief, lord chancellor, &c., the several departments going on as before, frequently under nominal heads of their own, we should get some distant parallel to the curious empire of the Romans. But the emperor remained a mere citizen, without a court or royal insignia of any kind. Men addressed him by his family name as they did other men; his own servants sufficed for his wants. His children were no more than other children, unless a vote of the senate or people clothed them with office. Claudius, afterwards emperor, was long a simple knight (*eques*) until under the rule of his nephew Caligula he was elected consul. This gave greater power to a good emperor, but at the same time removed many checks from a bad one. The sense of dignity, the forms of etiquette, the separation from other men, the legal and constitutional checks, keep many a vicious king within limits of decency and order; but Caligula, Nero, Elagabalus were as free to indulge their worst propensities as the first man along the street, and what is worse, with the command of unlimited means of satisfying them. On the other hand, a Vespasian, an Antoninus, and a Marcus Aurelius were enabled to hold familiar and unfettered intercourse with all who were wise and good and great, a privilege for ever denied to our crowned heads.

The empire was at first limited to Romans, to the Cæsars by birth or adoption: Julius, Augustus, Tiberius, Caius (Caligula), Claudius, Nero. But the successors of Nero, the Flavii, were Italians; and with Nerva the provincials ruled. Vespasian was a Sabine burgess, Trajan a Spaniard. Henceforward the highest dignities were open to all of Roman citizenship. Following the Flavian emperors, the great group of the Antonines immediately succeeds: Antoninus Pius, the wise Marcus Aurelius, the tyrant Commodus. Then after a long period of ninety-two years of practical anarchy, occupying the beginning of the great work of Gibbon ("Decline and Fall of the Roman Empire"), a third group of noteworthy emperors is added to the Cæsars and the Flavio-Antonines. This is the era of Diocletian and Constantine, when the first-named, one of the greatest of Roman rulers, first reorganized the vast dominion of Rome on some practically workable method. But among other changes Diocletian removed the seat of empire from Rome, and his successor Constantine definitely fixed it at the new Rome, which before his time had been called Byzantium, and ever since his day has been called Constantinople. Constantine further changed the state religion to Christianity. Henceforward we have an Empire of the East and an Empire of the West—the latter, with Rome as its fast-waning centre, growing less and less in power, till the city which began with a Romulus, and the empire which began with an Augustus, so also passed away—Romulus Augustulus ("little Augustus") being the last of the Western emperors. The Empire of the East continued, with alternations of strong reigns and of periods of anarchy such as are pointed out above as occurring in the united empire of Rome. The groups and dynasties of the Byzantine emperors, or emperors of the East (who still called themselves Romans), remain distinct and separate in the mind of the reader of Gibbon. The houses of Theodosius, Justinian, Heraclius, Leo, Basil, Comnenus, Angelus, and Palæologus are divided from each other by groups of ephemeral princes who rise, fall, and are forgotten. (As Freeman points out, much the same thing occurs in the long succession of the popes.) The Eastern Empire succumbed under Constantine XII. (a Palæologus) to the Turks under Mahomet II., in 1453.

From the long past emperors of the West this title, in the year 800, was revived to Charlemagne, the founder of the second Empire of the West, or Holy Roman Empire. Upon the expiration of the German branch of the Carlovingian family, the imperial crown became elective, but eventually became, as the Empire of Germany, an appanage of the house of Austria, and continued so until the last century, when the title of Emperor of Germany ceased. It was revived in the person of William I., king of Prussia, in 1871. Francis II., who laid it aside, assumed the title of Emperor of Austria. The only other European potentate who at present uses the style of emperor is the Emperor of Russia.

In 1876 very exhaustive discussions upon the title took place in the English Parliament, consequent on the proposal to apply to the queen the designation of Empress of India. It was held that under the Roman Empire the imperial title implied something more than simply a local or national king, and that it marked the chief of a confederation which had kings among its members. When the first Bonaparte called himself Emperor of the French, he certainly meant to proclaim himself as something more than a mere local king of France. He meant to set himself up as the successor of the Frankish emperors, and openly gave himself out as the successor of Charlemagne—not as the successor of the Bourbons. Looking at the matter in this light, the appropriateness of the assumption of the title by the King of Prussia in 1871 is obvious. The circumstances of our Indian "empire," with its numerous independent and semi-independent rulers, were considered by a very large number in the legislature as rendering the adoption of the title by the queen desirable. It was therefore proclaimed in the United Kingdom in the same year (1876), and in India the year following. The equivalent in Hindu is Kaisar-i-Hind.

EMPETRA'CEÆ is an order of plants belonging to the MONOCHLAMYDEÆ. They are low shrubby plants, with evergreen leaves and the aspect of heaths. One species, the *Empetrum nigrum* (the crowberry), is native, growing on the moors in Scotland and the north of England; the fruit is eaten in the arctic regions, and considered as scorbutic and diuretic, and a fermented liquor is also prepared from it. The Portuguese use a beverage in fevers prepared from the fruit of a species of Corema.

The species are chiefly natives of northern Europe and America. The flowers are nearly allied to those of Euphorbiaceæ, but the seed is ascending, and has an inferior radicle.

EM'PHASIS, in articulation, is the mode of drawing attention to the words of greater importance in a sentence by pronouncing them with a greater volume and duration of sound, and in a higher or lower note than the rest. It is in fact to the phrase what the *accent* is to each word. In music emphasis generally bears the name of *phrasing*, its object being the clear division and proper subordination of the several portions of the melody.

EMPHYSE'MA, in pathology, the name given to an unnatural distention of a part with air. Emphysema of the lungs frequently comes on as a sequel to chronic bronchitis and asthma, the tissue of the lungs being degenerated, and the breathing rendered short and difficult from this cause. Wounds of the lungs also often give rise to subcutaneous emphysema, and the same affection sometimes occurs from a rupture of the air vesicles during a violent expiratory effort.

EMPIRE. See EMPEROR.

EMPIR'IC. This word is derived from the Greek, and means a man who derives his knowledge from experience. A medical sect which arose in opposition to that of the Dogmatics assumed the name of Empirics. Serapion of Alexandria and Philinus of Cos are regarded as the founders of this school.

If the Empirics had remained true to their principles, their name would stand high among the medical profession. But having abandoned the study of the theory of nature, and with it all scientific pursuits, they sank into such disrepute that their name became a stigma. And even in our days, while true empiricism is the character of modern science and philosophy, the name of empiric is still bestowed as an opprobrious term upon all ignorant pretenders in the medical art who work by mere "rule of thumb" or practical recipes, regardless of theory or even common sense. The enlightened man of science joins a wise empiricism to enlightened hypothesis in the search after truth. Observation gives ground for hypothesis, which in its turn submits to verification by renewed observation. By these three steps alone, two of which are empirical, can knowledge increase.

EMPSON and **DUDLEY,** two lawyers who have earned a partnership of evil fame by serving as tools to the rapacity of King Henry VII. Edmund Dudley was of good family; Sir Richard Empson was by birth only the son of a sieve maker, but his brutal manners and unrelenting temper made him even fitter for the king's purpose than the other. Dudley was made speaker by the subservient Commons, and both he and Empson were barons of the exchequer. Empson and Dudley employed an army of spies, and brought men in crowds under the many conflicting penal statutes of the time, for the purposes of extortion. No charge was too frivolous for them to make, nor was any too grave or too well-proven for them to accept hush-money. Henry died in 1509, leaving by these vile means no less than £1,800,000 in his treasury, an almost fabulous sum if we consider the value of money in those days. The accomplices of the avaricious king were thrown into prison by his successor. Proofs of illegal and tyrannical practices abounded against them, and they were executed on Tower Hill, amidst general joy, on the 18th August, 1510.

EMPYE'MA, a word which signifies an internal collection of pus. Although this term was restricted by the ancients to purulent collections in the thorax, it is now employed to signify all collections of fluid in the pleura which do not arise from an obstruction to the circulatory system, and are not of a gaseous nature. In a natural state the pleura, like other serous membranes, secretes a clear fluid which is removed by absorption as quickly as it is formed. But from the existence of inflammation or the presence of foreign bodies, other fluids often accumulate. The most common of these are serum, blood, pus, and fibrinous matter. Any of them may be present alone, or may be mixed in varying proportions. It is, however, almost impossible to ascertain by any external means the nature of the fluid which has accumulated.

The worst effect of the presence of fluid in the pleura is exerted on the lung. By its pressure the lung becomes incapable of expanding for the admission of air. Its position is generally by the side of the spinal column; but through the deposition of the fibrous matter the pleura of the lungs and of the ribs often contract adhesions, and in this manner the lung may be forced to occupy very varied positions in the cavity of the thorax. When the effusion is extensive the lung becomes flattened and flaccid, its surface is corrugated, and its tissue becomes soft, pliant, and dense, exhibits no crepitation, and is almost entirely deprived of blood. It does not often become inflamed in this state, but frequently becomes the seat of the deposition of tuberculous matter.

Empyema is always attended with inflammation, acute or chronic, of the pleura [see PLEURISY], although the bursting of an abscess or the wounding of a bloodvessel may assist in producing the accumulated fluid contents of the pleura. At the same time it frequently happens that the inflammatory symptoms are of so mild and insidious a nature that they are entirely overlooked. This was more frequently the case previous to the use of percussion and auscultation than at the present day. There are few diseases with which empyema is likely to be confounded. Its general symptoms resemble those of tubercular phthisis, but the history of the disease, and more particularly the stethoscopic signs, will point out the distinction.

The treatment of empyema may be of two kinds, medical and surgical. The general principles on which the first should be conducted are those which would be applied in pleurisy. It, however, often happens that the resources of medicine fail, and that no other chance of relief can be offered the patient than that of drawing off the effused fluid by means of an operation. This is called the operation of empyema, or paracentesis thoracis. This operation, though it had at one time fallen into disrepute, has been found to add largely to the chances of recovery, and even where it fails to save life it tends to afford relief to the patient.

EMPYREU'MA, the peculiar smell and taste resulting from the action of heat upon organic substances in close vessels. Destructive distillation goes on so as to produce an oil which has a strong empyreumatic smell and taste.

EMS, a town of Prussia, in the province of Hesse-Nassau, in the government and 15 miles north of Wiesbaden. It is a place of great beauty, being built in a valley inclosed by wooded hills, near the most picturesque part of the Rhine.

The town is chiefly known for its mineral springs, and is often distinguished from places of the same name, as *Bad-Ems*. These springs were known to the Romans, and their chief medicinal ingredients are bicarbonate of soda and chloride of sodium. The temperature varies from 81° Fahr. in the coolest spring to 137° in the hottest. The resident population is about 6000.

EMS (the ancient *Amisus*), a river in the north-west of Germany, which has its source in a hill called Stapelag, near Paderborn, in Westphalia. Its course is first west, and then north-west past Wahrendorf and Rheine, where it quits Prussia proper and enters the Prussian province of Hanover. Through Hanover it flows in a northern direction for about 70 miles to its entrance into Dollart Bay, near Emden, by two mouths, the Oster Ems and the Wester Ems. In this part of its course, by means of canalization and deepening the bed of the river, the Ems is navigable. The principal towns on its banks are—Lingen, Meppen, Papenburg, and Leer. The whole length of the river is about 210 miles, and it is navigable for vessels of 80 or 100 tons burden as high as Papenburg, where it ceases to be affected by the tides. Its principal tributaries on the right bank are the Hase, which, passing Osnaburg, falls into it at Meppen; and the Leda, which enters Hanover from the district of Oldenburg, and joins the Ems near Leer. On the left bank the Ems receives the Aa, to the south-west of Papenburg.

E'MU (Dromæus) is a genus of STRUTHIONES, nearly allied to the CASSOWARY (Casuarius), but distinguished from it by the absence of a helmet or casque, by their feathered head, and by the stout curved nails to the toes. The common species, *Dromæus novæ-hollandiæ*, has become quite familiar to us from the frequency of its exhibition in menageries, and its breeding so readily in a state of domestication. Its food consists of vegetables and seeds, but chiefly of fruits, roots, and herbage. In a state of nature it is very fleet, and affords excellent sport in coursing with dogs, which are, however, rather shy of their game, in consequence of the powerful kicks that the bird can inflict—so powerful that the settlers say it can break the bone of a man's leg by striking out with its feet. Well-trained dogs, therefore, to avoid this infliction run up abreast, and make a sudden spring at the neck of the bird. The nest is merely a shallow pit scraped in the ground. The dark green eggs are six or seven in number. The birds appear to be tolerably constant in pairing, and the male bird sits and hatches the young while the female watches and guards the nest. The young birds exhibit black stripes upon a nearly white ground. The emu can produce a hollow drumming sort of note, well known to those who have attended to its manners in captivity. It alone of struthious birds naturally takes to the water. Its flesh is very good, particularly the hind quarters, and that of the young birds especially is exceedingly delicate; the eggs are also eaten both by natives and colonists, and the natives of some districts are said to live chiefly upon emus' eggs during the breeding season of these birds.

The emu is inferior in size only to the ostrich, measuring from 5 to 7 feet in height. It is diffused over the south-eastern part of Australia, but is gradually disappearing before the encroachment of civilized man. Its place is taken in West Australia by a second species, *Dromæus irrotatus*, distinguished by its speckled plumage.

EMUL'SIN or **SYN'APTOSE**, a fermentive substance contained in almonds, which in the presence of water converts the amygdaline into glucose, hydrocyanic acid, and hydride of benzoyl, or the well-known oil of bitter almonds, which does not exist ready formed in the fruit. Like most ferments it is soluble in water and precipitated by alcohol, in which it is insoluble.

EMUL'SION. An intimate mixture or combination of oil and water, effected by the addition of another substance which combines with both. The oil exists in minute globules, surrounded by the liquid. Sugar, gums, and alkalies are usually employed as media. Milk is the best known emulsion; in this fluid the butter, in exceedingly minute globules, is held in suspension by the sugar of milk. It is precipitated by an acid.

EM'YS. See TERRAPIN.

ENAM'EL. There exists evidence that the Egyptians practised the art of enamelling, but this cannot be affirmed of the Greeks. The Romans, however, have bequeathed abundant evidence that they were acquainted with the art, and practised it extensively, at least in the time of the later empire. The term enamel is often applied to the glaze of earthenware and other substances; strictly, however, it should be limited to such a glaze when fused to a metallic surface.

The famous Byzantine enamels were made by the *cloisonné* (Fr. *cloison*, a partition) process, which was also practised by the ancient Egyptians, and has long been a favourite among Chinese and Japanese enamellers. Ancient European cloisonné enamels were on a gold groundwork, on which were fixed fine threads of gold bent to the required pattern, so that a number of compartments were formed, into each of which its properly coloured enamel was poured. Then the whole being subjected to great heat the enamel was fused, and when all had cooled and hardened the surface was ground smooth. Byzantine cloisonné work is always flat or nearly so. The Chinese and Japanese, however, to whom we are indebted for some of the most beautiful and elaborate specimens of this style, enamel porcelain and copper vases and various rounded shapes in the same manner. Nos. 1 to 8 of the illustrations in the coloured Plate accompanying this volume are from specimens of Oriental cloisonné, both Chinese and Japanese: the wire which forms the *cloisons* being represented by the thin brown lines which may be observed bordering nearly all the designs.

Champlevé enamels (Fr. *champ levé*, raised ground) are generally on a copper base, which is cut out by engraving into chambers similar to those of the cloisonné, and the enamel is applied in a powdered state and fixed by fire as before. But many champlevé enamels take advantage of the process to be gone through in order to produce an effect special to this method. Thus if only part of the ground is incised and enamelled the remainder will form a metal background to it, or *vice versâ*; in this way many charming effects of contrast between metal and enamel are produced. If metal surfaces are left free they are usually engraved in accordance with the general design. Limoges was the chief centre of enamelling during the middle ages, up till about the fourteenth century, when the art fell into decay. Its fame, however, revived in a new form, that of enamel painting.

The painted enamels of Limoges have been celebrated for upwards of 300 years. Some specimens of the best work of the royal factory at Limoges are given in the Plate, Nos. 9, 10, 12, and 15; the originals are in the Louvre at Paris. The remaining specimens, Nos. 11, 13, 14, and 16, are contemporary Italian work from the leading *fabbriche* of the time, about 1525–1600. The process employed in this style of work was essentially different from that previously used. Formerly the enameller required the assistance of the engraver to mark out the outlines of the design: now the surface was perfectly smooth, as a panel of wood or canvas, and the subject was painted, the pencil expressing both form and colour. It is considered that the improvements in glass painting which were introduced about the end of the fourteenth century suggested this new mode of enamelling upon copper. As may be supposed, the early specimens of this art are very imperfect, and consequently, being deficient in beauty and value, have not been preserved. They are very rare. Towards the middle of the fifteenth century the art had made great progress. It may be interesting to describe the process used at that period. On an unpolished plate of copper the enameller traced the outlines of the subject to be represented. The plate was then overlaid with a thin translucent flux, after which the enameller began to apply his colours. The outlines were first covered with a dark-coloured enamel, which was to give the outlines on the surface of the picture; the draperies, sky, and accessories were then expressed by

enamel colours in thick layers. There was, therefore, a total absence of shadow in this painting, in which the first design was expressed by thickness of colour. The space for the flesh tints was filled with a black or deep violet enamel; they were then rendered upon this ground by white enamel applied in layers more or less thick in order to preserve the shadows, and thereby obtain a sketch very lightly in relief of the principal bony and muscular parts of the face and body; consequently all the carnations in this process have a bistre or violet hue, by which they may easily be recognized. In order to produce effect in the rest of the painting where the shadows were wanting, the light parts of the hair and drapery were frequently indicated by touches of gold. The imitation of precious stones upon the mantles of saints, &c., is peculiar to this description of enamels.

Modern enamelling is of two kinds—transparent and opaque. The first is employed for the purpose of ornamenting gold and silver snuff-boxes, watch-cases, and various articles of jewelry. Previously to the application of the enamel, various patterns and devices are *bright-cut* with the graver on the rose-engine, when the cuts reflecting the rays of light from their bright and numerous surfaces exhibit through the richly coloured enamels with which they are encrusted a beautiful play of colours. Sometimes this enamelled bijouterie is further adorned with paintings in enamel, executed on rich transparent grounds.

Opaque enamelling is employed in the manufacture of watch and clock dials, and of plates for pictures. For this purpose the enamel is first broken with a hammer into small pieces, and then ground with a pestle and mortar formed of agate. It is then spread evenly on a plate of copper, which has been prepared for its reception, and being passed through the furnace the enamel is melted, and adhering firmly to the metal thus forms an enamel plate. For the best kind of dials a second coat of enamel is laid over the first, and for pictures a third is added. The figures are painted on the dials in a vitrifiable colour, when they are again subjected to the heat of the furnace, which, melting the colour and softening the enamel at the same time, incorporates the two into one body, and thus permanently fixes the painting. Gold is frequently used instead of copper for small enamel pictures. When the enamel plate is prepared the artist proceeds to paint his picture in a similar manner to that which is pursued by the painter in oil or water-colours; a principal difference being, that instead of waiting for the colours to dry before proceeding to lay on another coat of colour, he has his work passed through the fire, by which process the colours are imperishably and immovably fixed. Paintings in enamel are usually subjected to the furnace ten or twelve times, and in some cases oftener. The colours are composed of a colourless glass as a base, the colouring matters being metallic oxides. Thus silica, borax, and the red oxide of lead form a base or flux for some colours. The habitudes of the various oxides, however, require that each should be treated with reference to its peculiar properties: for instance, the flux which, employed with gold, is best adapted for the production of a useful and beautiful colour, is wholly inefficient if used with cobalt.

The nature of the material and the expense attendant upon attempts to produce large works in enamel have tended to restrict the dimensions of enamel paintings. Until the time of the late H. Bone, R.A., and the late Charles Muss, but few attempts had been made to extend their size beyond that adapted for trinkets. Mr. Bone, with amazing perseverance and industry, overcame innumerable difficulties, and exhibited for a long series of years enamels of large dimensions. The largest works which have been executed in enamel are, "Bacchus and Ariadne," after Titian, by H. Bone, R.A.; and a "Holy Family," after Parmegiano, by Charles Muss. The former measures 16½ inches by 18; and the latter, 15¼ inches by 20½. George Bowles, Esq., purchased the "Bacchus and Ariadne" for 2200 guineas, and his Majesty, George IV., gave 1500 guineas for the "Holy Family." This last now forms part of the collection in Buckingham Palace.

The power of resisting decay renders enamel a valuable medium for conveying down the stream of time the likenesses of celebrated individuals. The artists who practise this durable and beautiful style of painting have not at any time been numerous, and even now there are in England very few who have attained any eminence.

To what is stated under the above head we may add a few words upon the process which has been extensively practised of late years of enamelling the interior of cast-iron and other hollow articles, such as saucepans and other culinary and domestic utensils. The superior cleanliness of such articles, and the security which they afford against any metallic taint, render them peculiarly valuable for some delicate operations in cookery and confectionery, and for the preparing of pharmaceutical decoctions, extracts, &c. The enamel used for this purpose may be stated, in general terms, to consist of silica, soda, borax, and potters' clay.

The basis of all enamel is a white transparent glass. The addition of some of those metallic oxides which merely impart colour, as gold, silver, copper, cobalt, &c., convert this into a transparent enamel; while those of tin and antimony, which render it opaque without imparting colour, form a white opaque enamel. There is also a material, of which the commercial name is glass enamel, the opacity of which arises from the presence of arsenic. This substance is very glassy, brittle, easily scratched, readily fusible, and very white: it is used for making the common kinds of watch and clock dials, ornaments for the mantel-shelf, &c.

ENCAMP'MENT is the lodgment or station of an army, with its artillery, baggage, and stores, when it has taken the field for the purpose of manœuvring or of acting against an enemy.

Encampments are of three kinds—1, hut or permanent encampment; 2, tent encampments; 3, bivouacs. The first is used only when troops go into winter quarters; the second is generally used during peace manœuvres; the last is used when armies are actually engaged, no troops ever having been able to carry tents when moving rapidly in the field.

Whatever the nature of a camp may be it should be made to conform to the following principles:—1, The front of the camp should correspond in extent with the front occupied by the force when deployed in line; 2, the means of passing freely through the camp with a wide front should be maintained; 3, the tents, huts, or bivouacs should be disposed with a view to the greatest amount of order, cleanliness, ventilation, and security; 4, the camp should be as compact as possible.

The length of the front of a battalion of 750 men, two deep, allowing 21 inches to each file, will be 219 yards: and this would be the extent of the line of tents were it not that the line is determined by the probable number of effectives instead of the numerical strength of the establishment. The depth of the encampment for a battalion is of less importance, but when the ground will permit it may be regulated as follows:—

The tents of the privates may be ranged in two lines parallel to the front, with an interval of about 12 feet as a street between every two companies in each line, and those of the captains and subalterns may be in one line in the rear of these; the field officers and the commanding officer may occupy a fourth line; the staff a fifth; and the line of kitchens may be in the rear of all.

The length of front for a complete regiment of cavalry, consisting of eight troops, when formed two deep, is about 320 yards; and this may be considered as the extent occupied by the regiment in the line of the encampment

The seven tents of each troop are ranged in a line perpendicular to the front, and the horses are attached to pickets in lines parallel to those of the tents, the remainder of the space, reckoned parallel to the front, being occupied by the breadths of the streets. In the rear of the men's tents and parallel to the front are arranged the subalterns' horses in one line; the tents of the captains and subalterns in another; those of the field officers and commanding officer in a third; and the kitchens in the rear of all.

A large army is encamped in two lines which, if the ground will permit it, are parallel to and at the distance of about 300 yards from each other; and a reserve, generally consisting of the best troops, is formed in rear of the second. The stations of the cavalry are on the flanks of each line. The artillery attached to an army is posted either on the flanks of the camp or with the reserve in the rear.

The circular tents at present in use are 13 feet 3 inches diameter within the walls (the canvas which hangs vertically between the conical part of the tent and the ground). Of the cavalry twelve men and of the infantry fifteen men are appointed to each tent.

The great extent of the space which is unavoidably occupied by an army in the field renders it in most cases impossible to fortify the site of the encampment by a continuous line of parapet like that with which the Roman armies surrounded themselves on taking up a defensive position, and the security of a modern army against surprises is now obtained principally by the situation being difficult of access, from streams, marshes, or inequalities of the ground, and by keeping numerous advanced posts to watch all the approaches by which an enemy might arrive at the camp.

A continuous line of works may, however, be admissible for an army inferior to that of the enemy, provided the extent of the line be not so great as to prevent the intrenchments from being sufficiently manned in every part; but a camp so fortified would possess no advantages for an army which is strong enough to assume the offensive on a favourable occasion presenting itself; and it is evident that in this case it would be sufficient to construct merely a few redoubts in situations from whence a fire of artillery might be directed for the purpose of defending the approaches, while the disposable force of the army might be kept in masses, ready at a proper time to make a movement to the front through the intervals between the works.

Temporary camps of instruction are sometimes formed to meet emergencies, such as exercising certain regiments in evolutions and preparing them for foreign service. Large permanent camps are now established at Aldershot, the Curragh in Ireland, Pembroke, and Colchester.

The French troops use *tentes d'abri*, small tents, which contain three men, and are carried by the soldiers themselves; but as it takes three men to carry one tent, if one man for any time is absent the tent is useless, and the soldier is at all times overweighted. The Prussian army has met this difficulty by arranging that the soldier shall always bivouac, and training him for this important duty during peace time.

ENCAUS'TIC PAINTING (Gr. *egkaustikē*), a kind of painting in which, by heating or burning in, the colours were rendered permanent in all their original splendour. It was not, however, enamelling, but a mode of painting with heated or burnt wax, which was practised by the ancients. Pliny ("Nat. Hist." xxxv.) describes three modes of encaustic painting. In the first mode the wax was melted, mixed with as much earth colour finely powdered as it could imbibe, and then this mass was spread on wood, or on wall, with a hot spatula, just as Turner and other artists have painted with their palette-knife. In the second mode ivory tablets were covered with red or black wax, and the design cut in it with the style, the object being to use the clear and smooth surface of the ivory for the lines, that they might look the more beautiful. The third kind was the applying the colours with the pencil. The wax was dissolved in some medium, the colours mixed with it, and laid on with the pencil, and the painting then finished by the wax being brought to the surface to form a sort of glaze, through careful approximation to the fire; for this purpose a hot iron (*cauterium*) was used.

This art, having been long lost, was revived by French and German artists in the eighteenth century, and is now occasionally practised, but only as a curiosity, for it neither gives the depth nor the permanency to the colours obtained by oil painting.

ENCAUS'TIC TILES were in use in England and France, for paving churches, as far back as the fifteenth century, but afterwards fell entirely into disuse, till the great exhibition of 1851, when, among many other branches of manufacturing art, the making of these tiles was revived, and has since increased rapidly. They are of two kinds—plain and figured. The first are of different colours, and square or triangular, forming a mosaic when laid. They are made by placing the clay, already mixed with the desired colour, into strong moulds, and putting on it such a pressure that 3 inches of powdered clay is compressed into a tile of 1 inch in thickness. They are then baked, fired, and glazed. In making the figured tiles cubical blocks of well-tempered moist clay are first used. These are cut into square slabs by a wire, then faced with a finer clay of the required colour, and put into a box-press or mould. A plaster of Paris slab containing the pattern in relief is then brought down upon the face of the tile, and the design impressed into the soft clay. The hollows thus made are filled with a semifluid clay, of the requisite colour to form the pattern, poured over the whole surface of the tile. It is then set aside till sufficiently hard and dry to have its surface cut down so as to expose the pattern and the ground, when the two colours of clay form one smooth flat surface. The tile is afterwards dried and fired.

ENCEINTE, in fortification, the inclosure of a place, or the rampart which surrounds it, and which is sometimes flanked by round or square towers.

ENCEPHALAR'TOS is a genus of plants belonging to the CYCADACEÆ. The species, twelve in number, are found in tropical and South Africa, and are known there as Caffer bread; the starch in the cells of the soft pith of the trunks and the interior of the female cone afford the natives a supply of food. The leaves are feather-shaped; they fall off as they become old, the younger leaves at the very top of the stem only remaining. The narrow leaflets have longitudinal parallel veins. The flowers are either male or female, and occur on distinct cones. The scales of the cones bear the flowers on their under surfaces, and overlap each other in several spiral series. The scales of the female cone are somewhat peltate, the shield portion being kidney-shaped, with the point turned down, and bearing two ovules.

ENCLIT'ICS are certain words in the Greek language which unite so closely with the words they follow as to lose their proper accent and throw back the accent to the preceding word. For instance, τὶς, a certain, when following a noun, as ἄνθρωπος, combines into the compound word ἄνθρωπός τι, a certain man.

The word is used also in English prosody to signify a somewhat similar transfer of accent. The interjection *Oh* becomes in this sense enclitic when used as the sign of the vocative, and when by correct writers it is now spelt *O*. For instance, the *O* in "True, O son!" is an enclitic, its accent passing to "son;" but "Oh! Son of God" carries the accent on the interjection itself.

ENCORE, a French word signifying *again*, often used by English audiences of theatres and concert-rooms to express their desire for the repetition of a part of the performance. The French people use *bis* (twice) in similar circumstances.

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The profession of the civil engineer comprehends the design and execution of every great work by which commerce and the practice of the useful arts may be facilitated. Thus he raises embankments to resist the encroachments of the sea, or to reclaim the land which it may have covered, and dams to break the force of its waves at the mouths of natural harbours. He renders rivers navigable when their course is obstructed by rocks or banks; he forms docks or artificial harbours where ships may remain in security; he is required to penetrate by mines to vast depths for the purpose of seeking the mineral

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ENGINEERING (from the French word *engin*) is properly the art of constructing and using engines or machines; but the term is also applied to that of executing such works as are the objects of civil and military architecture.

A distinction has long been made between the civil and military engineer. Since everything relating to the service of artillery is now confined to a particular corps, the duty of the military engineer may be said to comprehend the construction of fortifications, both permanent and temporary, including the trenches and batteries required in besieging places; also of barracks, magazines, and other works connected with warlike affairs. Military engineers are also employed in the trigonometrical survey of the United Kingdom, and in the construction and maintenance of the system of electric telegraph lines, now under control of the post office.

The profession of the civil engineer comprehends the design and execution of every great work by which commerce and the practice of the useful arts may be facilitated. Thus he raises embankments to resist the encroachments of the sea, or to reclaim the land which it may have covered, and dams to break the force of its waves at the mouths of natural harbours. He renders rivers navigable when their course is obstructed by rocks or banks; he forms docks or artificial harbours where ships may remain in security; he is required to penetrate by mines to vast depths for the purpose of seeking the mineral

treasures contained within the bosom of the earth; and the formation of iron roads or railways is now the most important branch of the profession. The profession of civil engineering is therefore subdivided into many different departments, according to the nature of the duties undertaken, such as railway, hydraulic, mechanical, mining, and marine engineering.

Of the national works executed by the ancients, and which are to be considered as properly falling within the province of the engineer, one of the first of which we have any intimation is the canal uniting the Red Sea and the Nile, which, according to Pliny, was begun by Sesostris, or according to Herodotus, by Necos, the son of Psammetichus, and finished by Darius I. The canal of Xerxes across the isthmus of the peninsula of Athos is another example of works of this kind. The introduction of arches in works of magnitude may be said to have constituted an epoch in the profession of the architectural engineer, since the idea of giving to blocks of stone a form which would enable them to sustain themselves in balanced rest by their mutual pressures, the discovery of the means of arranging them on a curve surface, and the determination of the magnitudes of the piers or abutments so that the lateral pressure of the vault might be adequately resisted, imply a higher degree of intellectual power than is exhibited in covering a space with a horizontal roof. The Cloaca Maxima [see CLOACÆ] at Rome is probably the most ancient example in Europe of this scientific construction. The dome of the Pantheon, and the various arches of the Thermæ and of other public buildings both at Rome and in the provinces, such as aqueducts and bridges, attest the grandeur of design, combined with purposes of public utility, which characterized the architects who lived under the early emperors.

Previously to the commencement of the eighteenth century, the most celebrated practical engineers were Brunelleschi, who built the dome of St. Mary at Florence; Peruzzi, San Gallo, and Michael Angelo, who executed that of St. Peter at Rome; San Michæli, the supposed inventor of the bastion system of fortification; Pagan and the great French engineer Vauban, who brought the art of FORTIFICATION almost to its present perfection.

Great as are the achievements, however, of the military engineers of the centuries mentioned, they have been fairly overshadowed by the more peaceful triumphs of our own time, some of which, like the railway tunnels under the Alps and the great maritime canal across the Isthmus of Suez, promise to be as enduring monuments of the skill of modern engineers as the pyramids of Egypt and the Roman roads and aqueducts of those of antiquity.

The rise of the railway system in England in 1830 gave the first great impetus to the development of civil engineering, though such works as Smeaton's Eddystone Lighthouse had already demonstrated their ability, and much had been done in mining engineering. The great tunnels and bridges which have made the names of Stephenson and Brunel famous were called into existence by the necessities of the railways, of which the bridges over the Tyne, the Menai Straits, and the Tamar at Saltash may be mentioned, only to be surpassed in our own time by the still greater bridges now in course of construction across the Friths of Forth and Tay and the tunnels under such estuaries as the Mersey and the Severn. Marine engineering became another branch of almost equal importance as successive improvements on the steam engine adapted it to the use of sea-going vessels; and as iron superseded wood in SHIPBUILDING the planning and equipment of the vessels themselves became one of the most important departments of engineering, calling into use the highest scientific knowledge of our time, well seconded by the practical skill of our working engineers and mechanics.

At first and for a long time the English engineers, to whom the practical introduction of railways and steamships had been mainly due, held the first position in their profession, but as these means of communication extended beyond our borders other countries were not slow to enter into competition with them, and from the greater difficulties some of these countries present it happens that some of the greatest works of our age have been planned and executed by the engineers of France, Italy, and Germany. We need only mention the tunnels under Mont Cenis and the St. Gothard, and the great maritime canal which the world owes to the initiative of M. de Lesseps and the skill of the French engineers. These are indeed so far from being satisfied with their past triumphs that they are already attempting the cutting of a canal across the Isthmus of Panama to connect the Atlantic and Pacific Oceans. In India and many other foreign countries the English engineers have carried on the struggle with nature's difficulties in a manner to reflect credit on their country; and their kinsmen in America have not been behind them, as is testified by the great lines of railway which now cross the American continent from ocean to ocean, with the numerous works which they necessitate, among which we may mention the giant suspension-bridge connecting the suburb of Brooklyn with New York.

The course of education by which a student may qualify himself to become an engineer, whether civil or military, must necessarily comprehend a greater extent both of the pure and physical sciences than would be required for a person who is to follow any other profession. The constant extension of the field in which the engineer is called to work renders almost every department of physical science a necessary part of a complete course of education, the whole being founded on an accurate knowledge of mathematics, now the basis of every exact science. To theoretical knowledge there must be added a thorough practical training in that department of his profession which is the special object of his attention. Only in this way can be attained that skilful and economical adaptation of means to ends, that inventiveness and power of accommodation to all circumstances which has distinguished the leaders of the profession.

England is rapidly extending the provision for efficient training. Although she has nothing exactly corresponding to the German Polytechnic Schools or to the French École des Ponts et Chaussées, most of the universities and colleges (except those of Oxford and Cambridge) have established professorates for instruction in engineering, and there are also many schools and colleges throughout the United Kingdom in which engineering is made a special study.

The Institution of Civil Enginee s, which was formed at London in 1818, has, by the publication of its *Transactions*, been the means of greatly assisting persons entering the profession, and through them of rendering service to society itself. Even established practitioners occasionally derive benefit from the theoretical investigations and the practical details of construction which are the subjects of the papers read at the meetings of the members.

ENGINEERS, MILITARY. In the British army there is a corps of Royal Engineers, consisting of officers of all ranks, from the colonel to the lieutenant, with a body of men, nearly all of whom are skilled workmen in some mechanical calling. In the construction of fortifications, trenches, and batteries, as well as in attacking and defending fortified works, this corps is of essential importance. The officers are required to be well acquainted with every department of mathematical and mechanical science, and to be able at any time to bring their knowledge into practical application. They are educated at the Royal Military Academy at Woolwich. Their pay according to grade is practically the same as that of officers of infantry of the same rank, but they receive in addition *extra pay*, amounting to one-half their ordinary pay when

at home, and equalling their ordinary pay when employed abroad, or in the London district.

In the engineering corps of her Majesty's service, the commissions have never been purchasable, as they once were in the Guards or in the line; but the officers have always been selected from the most promising pupils of the Military Academy. The nominations, however, for a considerable period chiefly depended on patronage. But a fairer and more impartial system of selection at the present time prevails. A public examination is held by the civil service commissioners in December and July of each year, when the number of candidates are selected by competition. The limits of age are from sixteen to eighteen, the candidates being required to be within those limits on the 1st day of January next following for the winter examination, and on the 1st of July for the summer examination. They must also be examined by a medical board and certified to be free from bodily defects and ailments, and in all respects fit for her Majesty's service. Those candidates who happen to be successful then remain under the instruction of the academy for two and a half years, when they must pass a satisfactory examination, then in the usual course they receive commissions in the Royal Engineers or Artillery.

There is an establishment of engineers in each colony to conduct and superintend all the military works and buildings. The period of regular service is twelve years, with power to re-engage for nine more, but the men can buy their discharge at any time. The average length of service is about five years, as so many inducements are held out to the men to enter civil employment.

ENGLAND, by far the largest and most populous division of the island of Great Britain, is separated from the northern part, or Scotland, mainly by the lower course of the Tweed, the line of the Cheviot Hills, and some small streams which fall into the Solway Frith. In other directions the frontier is formed by the North Sea on the east, the English Channel on the south, Wales and the Irish Sea on the west, and the Atlantic on the south-west.

The greatest extent of England, north and south, coincides with the meridian of 2° W., which intersects the country centrally from Berwick-on-Tweed to St. Alban's Head in Dorsetshire. The distance between these places measures 363 miles. A direct line drawn from south-west to north-east, connecting the Land's End in Cornwall with Winterton Ness in Norfolk, closely corresponds in length to the measurement north and south. But owing to the deep estuaries on the eastern and western shores being frequently opposite each other, or nearly so, as those of the Thames and the Severn, the Humber and the Ribble, the contraction is very considerable at these points, and dwindles to little more than 60 miles between the outlets of the Northumbrian rivers and the head of the Solway. Further north the width gradually narrows.

Bold and rugged features are conspicuous on the western side of the country, and appear through its whole extent from north to south, subject only to a few interruptions, and making a close approach towards the central districts. They consist of elevated heathy moors, with rounded masses rising above the general level, where stone walls often take the place of hedgerows; and of properly mountainous tracts in the form of ranges and groups. Three distinct regions are thus constituted—the Pennine chain, the Cumbrian or Lake group, and the south-western highlands.

The Pennine chain starts from the Scottish border, and is a continuation of the Cheviot Hills, the highest point of which, distinctively called the Cheviot, 2668 feet in elevation, is within the limits of Northumberland. From the western extremity of these hills the range has a southerly course of upwards of 200 miles. It terminates in the central part of Derbyshire, thus advancing through the northern counties towards the midland; and is locally styled, from its longitudinal direction, the "backbone" of England. There is no well-defined continuous ridge, but a succession of high moors, from 10 to 30 miles broad, upon which mountainous masses are irregularly interspersed. One material depression occurs, formerly traversed by the Roman Wall, now available for the passage of the Newcastle and Carlisle Railway. Several heights in the west of Yorkshire are considerably above 2000 feet; but the loftiest is in Cumberland, near its convergence with the counties of Westmorland and Durham. This is Cross Fell, the summit of which rises to 2927 feet above the sea, and long retains the winter's snow, feeding the South Tyne and the Tees, both of which have their sources on the eastern slope. The Pennine chain forms the great water-shed of the north of England, dividing the rivers which flow westerly to the Irish and easterly to the North Seas. It is entirely composed of rocks belonging to the carboniferous system, the mountain limestone, and millstone grit; and is remarkable for its picturesque dales, with numerous and extensive cavern formations.

The Cumbrian mountain group, though connected with the preceding range, is geologically distinct, rises higher, and has an entirely different and much grander character. It overspreads the south of Cumberland, a portion of Westmorland, and a small part of the north of Lancashire, having an extent of about 35 miles from east to west, and the same from north to south, where the expansion is the greatest. Slate rocks are the main constituents, steep, bold, and angular, well clothed with wood, and with the finest greensward on the lower slopes, associated with clear lakes in the long narrow valleys, and with numerous waterfalls, forming a combination of scenery which annually attracts a crowd of summer visitors. Sca Fell, in Cumberland, the principal elevation, has two summits separated from each other by a deep chasm, and differing but little in their height. The loftiest, styled the High Man, 3208 feet above the sea, is the highest point of England, from which may be seen the whole western coast stretching from the island of Anglesey to the Mull of Galloway. Not a blade of grass appears at the top, but there are tufts of crisp brown moss and splendidly-coloured lichens. Helvellyn, but little lower, 3055 feet, is much larger in bulk, yet is so closely invested with huge neighbours that there is scarcely a point of view from which the eye can embrace its full proportions. Skiddaw, of almost exactly the same elevation (3058), is the most imposing member of the group, as it is so far isolated that the entire mass can be seen at once from base to summit.

The south-western highlands consist of a series of ranges and plateaus bordering on the estuary of the Severn and the Bristol Channel, and extending through the counties of Devon and Cornwall. They include the oolitic Cotswold Hills, in Gloucestershire, on the eastern slope of which the Thames has its principal source, and named after the numerous sheep-cots upon them in former times; the Mendips, in the north-east of Somerset, chiefly of mountain limestone, with a flat summit and rapidly sloping sides; the Quantock Hills and the Blackdowns, in the same county, forming the northern and southern boundaries of the vale of Taunton; the high tracts of Dartmoor and Exmoor in Devon, and some granitic heights irregularly distributed through Cornwall. Several points closely approach the altitude of 2000 feet, but only one exceeds it, Yes Tor on Dartmoor, 2050 feet, an elevation which no other part of England south of Yorkshire attains to. Dartmoor is an extensive plateau, more than 20 miles across, lying between Exeter and Plymouth, bleak, woodless, and extremely wild, broken into numerous knolls, on many of which are blocks of granite of enormous dimensions, provincially termed *tors*, and intersected with rapid streams, torrent-like after heavy rains. Exmoor, in the north of the county, extending into Somersetshire, has similar features, and culminates in Dunkerry Beacon, 1688 feet.

The Brown Willy, the loftiest of the Cornish heights, does not reach that altitude.

High grounds, not included in the preceding regions, are the eastern moorlands of Yorkshire, chiefly of oolite, which terminate on the shore in bold headlands; and the two chalk-ranges which diverge eastwardly from Wiltshire, and traverse the southern counties. The South Downs run through Hampshire into Sussex, gradually nearing the coast, and protecting it from cold north winds, extending to Beachy Head, where they meet the waters of the Channel. They are cut by transverse valleys into separate masses, have a remarkably smooth rounded outline, exhibit great bay-like openings, and are clothed with the short sweet herbage which renders them famed as a sheep-walk. The North Downs stretch through the north of Hampshire, intersect Surrey and Kent, terminating in the cliffs beyond Dover. The Inkpen Beacon, near the converging points of Wilts, Hants, and Berks, rises 1011 feet, and is the highest mass of chalk in the kingdom. A third chalk-range runs from the Thames, through Oxfordshire, Bucks, and Herts, under the name of the Chiltern Hills, and proceeds north-east to the coast of Norfolk, but with a greatly declining elevation.

The whole of the central and the eastern districts of England, with large tracts in the northern, western, and southern counties, have a surface diversified occasionally with bluff hills, but more generally exhibiting gentle knolls and broad river-valleys, in connection with some entirely level lands. These form the country of the hawthorn-hedge, the daisied mead, and shaded homestead, in which

> "Corn-waving fields, and pasture green, and slope
> And swell alternate."

The greatest extent of level land lies around the shores of the Wash. This is the district of the Fens, so called from the meres and marshes with which it was formerly overspread, now one of the most productive parts of the country.

From the principal highlands running north and south, while occupying a westerly position, it follows that the general slope of the country is from west to east, in which direction the more important rivers are formed, flowing to the North Sea, with the exception of the Severn. All the chief rivers are described either in separate articles or in the counties through which they run.

The superficial area of England amounts to 50,922 square miles. In the main the country consists geologically of sedimentary rocks, generally rich in organic remains, animal and vegetable, but of various ages, different mineral character, and containing diverse fossils. Speaking broadly, all the Palæozoic rocks would be cut off by a diagonal line from Cornwall to Lincolnshire, the formation getting more and more recent as a whole towards the south-east corner. Finally we have the Pleistocene deposits of the London basin, &c., the most recent formation in the country. Its mineral riches of coal and iron are very great.

In the variety, extent, and value of its manufactures England surpasses every other country, while the products have a high character for excellence in all the markets of the world. This eminence is the joint result of moral, political, and physical causes. Much is undoubtedly due to the practical temperament and energy of the people, along with the mechanical genius of individuals. But the security attending the accumulation of property under a government which respects its rights enters into the solution of the problem, as well as that immunity from foreign invasion which is the consequence of an insular position. At various times skilled artisans have flocked to England in great numbers from the Netherlands and France, to escape from civil or religious oppression, and have introduced new industrial pursuits, or given the benefit of their experience and knowledge to existing handicrafts. But one of the main causes of the superiority is the possession of the vast mineral stores referred to—the natural implements of manufacture—with a convenient highway in the surrounding ocean along which to receive the raw material of other nations, and return the products of industry in their manufactured form.

England is divided into forty counties or shires of widely varying dimensions, as will be seen by the subjoined table, which gives their area and population in 1881:—

County.	Area in Statute Acres.	Population.		
		Persons.	Males.	Females.
Bedford,	294,983	149,473	70,354	79,119
Berks,	462,210	218,363	108,431	109,932
Buckingham,	477,151	176,323	86,840	89,483
Cambridge,	524,935	185,594	91,277	94,317
Chester,	657,123	644,037	311,188	332,849
Cornwall,	868,665		155,115	175,571
Cumberland,	970,161	250,647	124,746	125,901
Derby,	658,624	461,914	232,504	229,410
Devon,	1,655,208	603,595	285,340	318,255
Dorset,	627,265	191,028	93,736	97,292
Durham,	647,592	867,258	443,973	423,285
Essex,	987,032	576,434	288,180	288,254
Gloucester,	783,699	572,433	269,470	302,963
Hants,	1,037,764	593,470	293,050	300,420
Hereford,	532,918	121,062	59,809	61,253
Hertford,	405,141	203,069	98,792	104,277
Huntingdon,	229,515	59,491	29,195	30,296
Kent,	995,392	977,706	478,653	499,053
Lancaster,	1,208,154	3,454,441	1,669,864	1,784,577
Leicester,	511,907	321,258	155,881	165,377
Lincoln,	1,767,879	469,919	235,219	234,700
Middlesex,	181,317	2,920,485	1,367,692	1,552,793
Monmouth,	370,350	211,267	108,262	103,005
Norfolk,	1,356,173	444,749	215,266	229,483
Northampton,	629,912	272,555		136,893
Northumberland,	1,290,312	434,086		218,204
Nottingham,	527,752	391,815	190,778	201,037
Oxford,	483,621	179,559	88,025	91,534
Rutland,	94,889	21,434	10,764	10,670
Salop,	844,565	248,014	124,157	123,857
Somerset,	1,049,812	469,109	220,582	248,527
Stafford,	748,433	981,013	492,009	489,004
Suffolk,	944,060	356,893	174,606	182,287
Surrey,	485,129	1,436,899	683,228	753,671
Sussex,	933,269	490,505	232,331	258,174
Warwick,	566,271	737,339	357,146	380,193
Westmorland,	500,906	64,191	31,515	32,676
Wilts,	866 677	258,965	128,114	130,851
Worcester,	472,453	380,283	184,205	196,078
York, East Riding,	750,828	315,460	156,929	158,531
" City.	1979	49,530		25,573
" North Riding,	1,361,664	346,260	174,897	171,363
" West Riding,	1,768,380	2,175,314	1,064,218	1,111,096
Total,	32,527,070	24,613,926	11,961,842	12,652,084

HISTORY.—England was originally called *Engla-land* and *Engle-land*, which means the land of the Angles or Engles. Under BRITAIN the England of the Romans is described, the present article taking up its history after their departure.

According to the statement of Bede, which, repeated in the English Chronicle, is the only distinct account we possess of the English conquest of Britain in the fifth and sixth centuries, except the vague monotonous plaint of the eye-witness, the Monk Gildas, the English consisted principally of three nations or tribes, the Jutes, the Angles, and the Saxons. These occupied respectively modern Denmark, modern Schleswig, and modern Holstein—Jutes to the north, Saxons to the south. The Romans called them all Saxons, since they knew only the southernmost; whence our long absurd designation of the English before the Norman Conquest as Anglo-Saxons, an error which has caused many to regard our own ancestors, speaking our own tongue, as foreigners and strangers. For it must not be forgotten that *Englisc* is only the older name of both race and tongue now called English. See ENGLISH LANGUAGE and ENGLISH LITERATURE.

The first of the English that arrived after the departure

of the Romans are described as having been a body of Jutes, under two leaders named Hengest and Horsa. They arrived A.D. 449 at Ebbsfleet in Kent. They were followed in A.D. 477 by a body of Saxons under Ella, who made their descent on the coast of Sussex. The next leader that arrived was Cerdic, who occupied Wessex with another colony of Saxons, in A.D. 495. The Saxon immigrants appear to have eventually occupied Sussex, Essex (with Middlesex), and Wessex (West Seaxna), the latter in its greatest extent comprising the south part of Hertfordshire, Surrey, Hampshire (with the exception of the coast opposite to the Isle of Wight), Berkshire, Wiltshire, Dorsetshire, Somersetshire, Devonshire, and part of Cornwall. It was not till the year 527 that the first Angles arrived. From that time they made a succession of descents under various petty chiefs, whose names have not been preserved, upon the coasts of Suffolk and Norfolk (East Anglia), and eventually occupied what is now Yorkshire (Deira). In 547, however, a much more numerous body of them than had yet appeared landed, under the conduct of Ida, on the coast between the Tweed and the Forth, and eventually established themselves in the country to the north of the Humber (Bernicia). Deira and Bernicia ultimately united about 600 to form the great Anglian kingdom of Northumbria. A descent from the Humber along the Midland rivers about 582 gave mid-England to the Angles under the name of Mercia, *i.e.* the "march" or borderland between the English and Cymry. Thus was the so-called Saxon heptarchy or seven-kingdoms formed—Kent (Jutes); Sussex, Essex, Wessex (Saxons); Northumbria, East Anglia, Mercia (Angles or English). But at no time were there exactly seven kingdoms, and for a considerable time the English tribes were as independent in the new-won Britain as they had been among their own flat lands of Elbe in the older Engla-land beyond the sea. The Angles thus obtained possession of the whole of what is now called England, with the exception of the parts already mentioned as occupied by the Jutes and Saxons. They also extended their settlements over a great part of the south of Scotland, Bernicia extending at least as far as the Forth.

The most powerful among their kings often assumed the title of Bretwalda or Emperor of Britain. The following is the succession of the Bretwaldas as given by Bede:—1, Ella, who was king of Sussex from 491 to 518; 2, Ceawlin, of Wessex, from 568 to 589; 3, Ethelbert, of Kent, the first Christian English kingdom, from 589 to 616; 4, Redwald, king of East Anglia, from 616 to 642; 5, Edwin, of Northumbria, from 624 to 633; 6, Oswald, of Northumbria, from 635 to 642; 7, Oswi, of Northumbria, from 642 to 670. Wulfere of Mercia now attained the overlordship of England, and heathendom was for a time triumphant. Egfrith of Northumbria, virtual ruler of England, like his predecessors, fell before the Mercian heathens at Nechtansmere in 685. Mercia, soon becoming Christian, retained the lead for about 150 years. Then the Emperor Charles the Great (Charlemagne) aided revolt after revolt against Offa of Mercia on the part of the sub-kingdoms which he ruled. Eventually our first foreign treaty in 794 was signed between Charles and Offa. But on Offa's death in 796 the Frank emperor vigorously assisted his friend and protégé, Egbert, to recover the throne of Wessex from Mercia, which he accomplished in 800. Egbert of Wessex is reckoned the last Bretwalda of England, and is considered to have attained that dignity in the year 827. Upon the whole the title of Bretwalda cannot well be regarded as anything more than an epithet of distinction. It certainly carried with it no real or legal authority, beyond that of the power of its actual possessor.

Egbert swiftly brought kingdom after kingdom under his overlordship, and by 827 reigned paramount (though not over a united kingdom) from the Channel to the Forth. Even Wales submitted nominally to his rule. But the Danes soon wrested the Anglian parts of the kingdom from the supremacy of Wessex, and Alfred the Great ruled but over southern England. It was not till Edgar (958–975) and his great minister Dunstan that England could be said to be one kingdom, and that under a Wessex monarch, though his predecessor Athelstan had for a brief moment after the battle of Brunanburh (937) seen the whole land acknowledge him as king.

From 1012 to 1042 England was under Danish monarchs, the Danes having eventually destroyed the sovereignty of Wessex, as the Franks had overthrown the overlordship of Mercia. In 1042 Edward, the heir of Wessex, was recalled, the last of the Danish kings proving mere brutal tyrants unable to be endured; and this Edward, named the Confessor for his monkish virtues, ruled England, or rather permitted Earl Godwin and his sons to rule it, till 1066. In that year Edward died, and one of Godwin's sons was called by the unanimous voice of England to the throne; but in only a few months he was attacked by William, duke of Normandy, upon a very shadowy claim derived from a supposed gift of the crown to William by Edward; and at the battle of Senlac, commonly called the battle of Hastings, on 14th October, 1066, the land of England passed to Norman rulers, and the great bulk of the lordships and estates were given over to foreigners. Now were two races dwelling in England, quite alien to one another in tongue and in manners, conquerors and conquered—Norman-French and English. Yet these Normans, descendants of Norsemen, were practically of the same race with the Danes, now an integral part of the English people, and the Danes were nearly allied to the Angles, so that it only needed a few centuries for this new element to mingle itself indistinguishably with those that went before it, and to add its many virtues to the common stock. It must be noted that since Norman kings succeeded the Danish, and Angevin kings the Norman, England was for at least two centuries ruled by foreigners; not until the Angevins became themselves Englishmen, say under Edward I., did Englishmen again rule England. It is quite undoubted that to the mixture of Danish and Norman blood with the Anglian race England owes a great share of her present power.

The *Norman* dynasty died out as far as males were concerned with the sons of the Conqueror; and the succession was disputed and eventually shared between the daughter of his son Henry (the Empress Maud) and the son of his daughter Adela (King Stephen). At Stephen's death the son of Maud or Matilda succeeded to the throne as Henry II., in 1154. Details of the reigns of these and of all other English kings will be found under the articles on the separate reigns.

The *Angevin* kings (or "Plantagenets," Geoffrey of Anjou, Henry's father, habitually wearing a sprig of broom, *planta genista*, as a cognisance in his helmet) were still more foreign than the Normans. As a race they endured the longest and were the finest set of rulers of all our kings. The busy worker Henry II., the fiery Richard I. (Lion-heart), the noble Edward I. (Edward the Great), the imposing Edward III., are the great figures under whom England consolidated itself into one folk, with political institutions, laws, language, habits, and customs as we now find them. Centuries have but developed the England of Edward I., not changed it. One of his laws (if unrepealed) is as valid in our Parliament as it was in his. Nay, the great charter extorted from John in 1215 is to this day the basis of the national polity. Even the faithless John and the vicious second Edward were men of acknowledged power, men who in the death-struggle with the turbulent baronage were luckily worsted, but who made the fight not an unequal one, and yielded rather from circumstances than by sheer defeat. The last of the line, Richard II., was acknowledged to possess brilliant abilities, but his inconstant and treacherous character succeeded in

alienating the whole of his subjects, and he was easily overthrown by his relative the Duke of Lancaster, in 1399. With Richard closed the Plantagenet dynasty, after a tenure of the crown of over 250 years.

The *Lancastrian* house reigned by a purely Parliamentary title, however Henry IV., with characteristic subtlety, might seek to disguise it at his coronation. He was as strictly an elected sovereign as was Harold the Englishman or William the Norman; and his knowledge of the fact gave Parliament the supremacy for which all through the times of the three Edwards it had been vainly struggling. The second of the Lancastrian kings prosecuted with splendid success the Hundred Years' War which Edward III.'s shadowy claim to the French crown had set on foot between England and France in 1336, and in pursuit of which he had won the famous victories of Crecy (1346), and Poitiers (1356). Our Henry V. was indeed acknowledged after Agincourt as the future king of France, to assume the crown so soon as the then French king should die, and at the close of Henry's life he was ruling that country (what of it was not in arms under the Dauphin) as regent. Henry VI., son of the conqueror and of the daughter of the poor mad King of France, inherited the subtle malady of his French grandfather. Weak, amiable, and never quite sane, his were no hands to guide England and France. Town after town was lost on the Continent, and the enthusiasm and fearlessness of a simple village girl (Joan of Arc) was sufficient to drive the English back, till in 1451 Calais alone remained in English hands. (Under Queen Mary this too was lost in 1558.) The loss of the great southern provinces of Guienne and Aquitaine, which had been English dukedoms ever since Henry II. acquired them with his wife, was even a greater shame to England than the abandonment of the poor claim to the French crown. Yet there is no doubt that in that loss was great gain in the long run. England was now free to take or leave continental politics as she chose; and, protected by the "silver streak" of the Channel, might rise to freedom and prosperity unknown among the jarring nations of the Continent. But first she had a terrible trial to pass through—the suicidal wars of the Roses, arising out of the claims of the House of York to the crown. [See EDWARD IV.] The red Rose of the Lancastrians, after a most chequered contest, in which all the chivalry of England perished, finally succumbed to the white Rose of the Yorkists at Tewkesbury in 1471.

The *House of York* had a far stronger claim to the throne than that of Lancaster, since the Duke of York descended from an elder son of Edward III., the common ancestor of the two houses. Besides this the reduction of the power of the baronage by the long and deadly civil war, and the strong character of King Edward IV., sufficed to destroy the supremacy of Parliament observed under the Lancastrians. A "new monarchy" was founded; and when the Lancastrian party ultimately defeated the Yorkists and their last king (Richard III.) at Bosworth in 1485, and the Earl of Richmond (son of Edmund Tudor) led them to final triumph, the latter, under the style of Henry VII., was able to continue easily the nearest approach to a pure despotism known in England since the days of the Normans.

The *Tudor* dynasty was welcome enough. Henry VII. married the heiress of York, and adopted a party-coloured rose as his badge, in token of the final conclusion of the great war. Reformation of the church was now the great work, and England under the despotism of the Tudors was whirled in quick succession, as each monarch ruled, from Roman Catholicism with the supremacy of the pope to that without the supremacy of the pope (Henry VIII.); from that, under Edward VI., to a Lutheran Protestantism, followed by a recoil to the other end of the scale under Mary, who turned, as well as she could, the whole state to the obedience of the pope. Finally, Elizabeth trimmed the sails of the state church between the projects of her brother and her sister, and left it as we know it to-day.

The *Stuarts* followed the maiden queen, her relative, James VI. of Scotland, ascending the throne of England as James I. in 1603. The attempt by an alien king to carry on the stern policy of the Tudors, and to force conformity to the Church of England upon the ever-increasing Puritan party, led, in the time of his son, to the great rebellion, the execution of Charles I. in 1649, the first exile of the Stuarts, and the establishment of a Commonwealth under the glorious Protector, Oliver Cromwell. After his death the existence of the Commonwealth or republic ceased, and the Restoration established the profligate Charles II. in almost absolute power in 1660. The revenues were squandered; the King of England was a paid spy of France, an idler among women and dogs; the Dutch insulted us in the Thames and the Medway—truly England sank into a terrible slough of despond in those days. The bigoted and obstinate James II., following the sensual Charles, was quickly driven out by a now indignant nation, and the Stuarts were exiled for the second time and for ever in 1688.

William of Orange had married one of the Protestant daughters of the Roman Catholic ex-king James II., and he and that daughter (Mary II.) were elected joint sovereigns, the liberties of the nation being formally secured by the BILL OF RIGHTS. The other daughter, *Anne*, succeeded her brother-in-law. Anne dying childless, and the Protestant succession being definitely adopted as indispensable to the well-being of the land, the nearest available heir was a descendant of James I., the elector of Hanover.

The *House of Hanover*, or as it is more commonly called, the *House of Brunswick*, came to the throne at the death of Queen Anne in 1714, by virtue of an Act af Parliament. Thus, most fortunately, is it at last apparent to every one that the sovereignty of England rests on the English people in Parliament assembled. A feeble attempt of George III. (the first English-speaking king of the Hanoverian dynasty) to create a "king's party" failed; and the constitutional monarchy of England is probably at present the most stable system of representative government (as it is by far the most ancient) to be found in the whole world. Further, the English constitution being the result of development may itself develop further as need may arise; no "charter" or paper "constitution" exists in this happy land. There is no bar to progress in whatever way the nation wills; consequently the evils of civil war, unknown among us for two centuries and a quarter, seem likely never again to curse our country. The loss of the crown of France and of the dukedom of Aquitaine under Henry VI. have been mentioned above. The gain of the COLONIES, founded by England herself, has balanced it a thousandfold, and is elsewhere described. Had not the folly of George III. and his ministers cost us the brightest jewel of all, the group of colonies which now call themselves the United States of America, England would be at this moment mistress of the greater part of the civilized world. As it is, the sun never sets on the queen's dominions; every climate, every race, every part of the world owns here or there her sway; and the difficulty of our statesmen is to hold back from the perpetual extension which invites us ever onward, now in Africa, now in Australia, and now in Asia. That England may always be found equal to these immense responsibilities, the main burden and weight of which rest upon this one small island in the Atlantic, is the hope and prayer of all her proud children.

CONSECUTIVE LIST OF KINGS OF ENGLAND.—It may be convenient to give this list as well as the principal genealogical tables necessary to understand the claims on the crown of the various dynasties so far as they arise from descent.

GENEALOGICAL TABLES.

I.—Connection of the house of Wessex with the Danish kings and with the Norman kings.

First wife.=ETHELRED II.=2. Emma of Normandy, who married, after Ethelred's death, CANUTE.

EDMUND IRONSIDE. — Edward.
- Edgar, elected 1066.
- Margaret, m. Malcolm King of Scots. — Matilda, m. HENRY I.

EDWARD THE CONFESSOR.

CANUTE:
- by first wife, HAROLD II.
- by Emma, HARTHACNUT.

(Emma of Normandy was the sister of the grandfather of William the Conqueror, who was thus related to Edward the Confessor. William was illegitimate.)

II.—Claim of Edward III. to the French crown.

Philip III. of France.
- Philip IV. — Isabel, all whose brothers reigned and died childless, m. EDWARD II. of England. — EDWARD III.
- Charles of Valois. — Philip VI. of France, claiming against his English cousin by virtue of the exclusion of females from the French crown.

III.—Claims of York, Lancaster, and Tudor.

EDWARD III.
- 3rd son, Lionel D. of Clarence. — Philippa, m. Edm. Mortimer. — Roger Mortimer. — Anne Mortimer, m. Richard E. of Cambridge. — Richard D. of York. — EDWARD IV. — Elizabeth, m. Henry VII.
- 4th son, John of Gaunt, Duke of Lancaster.
  - HENRY IV. — HENRY V. whose widow marr. Owen Tudor. Their son was Edm. Tudor, Earl of Richmond.
  - John Beaufort, illegitimate, E. of Somerset. — John Beaufort, D. of Somerset. — Margaret Beaufort.
  - Edm. Tudor = Margaret Beaufort. — HENRY VII., m. Elizabeth of York.
- 5th son, Edmund D. of York. — Richard E. of Cambridge, mar. Anne Mortimer, heiress to the crown. (See under 3rd son.)

IV.—Claims of the Stuarts and of Lady Jane Grey.

HENRY VII.
- HENRY VIII.
  - by Kath. of Aragon.
  - by Anne Boleyn.
  - by Jane Seymour. — EDWARD VI.
- Margaret, m. James IV. of Scots. — James V. of Scots. — Mary Q. of Scots, m. Henry Stuart Lord Darnley. — JAMES I. (James VI. of Scots.)
- Mary, m. (2) D. of Suffolk. — Frances Brandon, Duchess of Suffolk, m. Henry Grey. — LADY JANE GREY, proclaimed Q. at death of Edward VI. in 1553.

V.—Claim of the House of Hanover.

JAMES I.
- CHARLES I.
  - CHARLES II.
  - JAMES II.
    - by Anne Hyde, MARY II. ANNE.
    - by Mary of Modena, James, old Pretender. — Charles Edw. young Pretender.
  - Mary, m. William of Orange. — WILLIAM III., m. MARY II.
- Elizabeth, m. Elector Palatine. — Sophia, m. Elector of Hanover. — GEORGE I. — GEORGE II. — Frederick P. of Wales. — GEORGE III.
  - GEORGE IV.
  - Edw. D. of Kent. — VICTORIA.
  - Ernest King of Hanover, D. of Cumberland. — George V. of Hanover, last King.
  - Augustus Duke of Sussex.
  - Adolphus D. of Cambridge. — George D. of Cambridge (commander-in-chief).

House of Cerdic of Wessex.—Egbert (descendant of Cerdic) ascended 802; Ethelwulf, son, 837; Ethelbald, son, 858; Ethelbert, brother, 860; Ethelred I., brother, 866; Alfred the Great, brother, 871; Edward the Elder, son, 901; Athelstan, son, 925; Edmund I., brother, 940; Edred, brother, 946; Edwy, nephew, 955; Edgar, brother, 959; Edward the Martyr, son, 975; Ethelred II., the Unready, half-brother, 979; Edmund II., the Ironside, son—jointly with Canute—1016.

Danish Kings.—Swegen, usurper, 1012; Canute, son, 1017; Harold I., son, 1035; Harthacnut, half-brother, 1040. Harthacnut's mother, Emma, was the widow of Ethelred II., and had married Canute as a second husband.

House of Cerdic restored.—Edward the Confessor, son of Ethelred II and Emma, therefore the half-brother of Harthacnut by the mother's side, ascended 1042.

House of Godwin.—Harold II., elected 1066.

(Edgar, grandson of the Ironside, was elected after Harold's death in 1066, but retired.)

Norman Kings.—William the Conqueror, duke of Normandy, elected King of England by the witan after Senlac, 1066; William II. (Rufus), son, 1087; Henry I., brother, 1100; Stephen, brother-in-law, 1135.

Angevin Kings (or Plantagenets).—Henry II., duke of Anjou, grandson of Henry I., ascended 1154; Richard I., Lion-heart, 1189; John, brother, 1199 (lost Normandy

1204); Henry III., son, 1216; Edward I., the Great, 1273; Edward II., son, 1307; Edward III., first king of "England and France," a title long retained by our monarchs (Edward's mother, Isabel, being the daughter and, as Edward claimed, the heiress of Philip IV. of France), son, 1327; Richard II., grandson, 1377.

House of Lancaster.—Henry IV., grandson of Edward III. (son of Edward's fourth son), elected 1399; Henry V., son, 1413; Henry VI., son, 1422, lost France 1451.

House of York.—Edward IV., great-great-grandson of Edward III. (descending by his mother from Edward's third son, as well as by his father from Edward's fifth son), usurper, 1471; Edward V., son, 1483; Richard III., uncle, 1485.

House of Tudor.—Henry VII. (his mother a granddaughter of John Beaufort, illegitimate son of John of Gaunt, the head of the *house of Lancaster*, fourth son of Edward III.; the Beauforts had been legitimated, but their royal succession barred), usurper, ascended 1485; Henry VIII., son, 1509; Edward VI., son, 1547; Mary I., half-sister, 1553 (lost Calais, last English town in France, 1558); Elizabeth, half-sister, 1558. (Lady Jane Grey was proclaimed Queen of England, according to the will of Edward VI., in 1553; she was granddaughter of a daughter of Henry VII.—exactly the claim of Mary Queen of Scots, but Mary's ancestress was the elder daughter, and her claim therefore superior.)

Stuart Kings.—James I. (his mother, Mary Queen of Scots, was great-granddaughter of Henry VII.), succeeded 1603; Charles I., son, 1625; Charles II., son, nominally 1649, really 1660; James II., brother, 1685.

The *Commonwealth* lasted from 1649 to 1660; Oliver Cromwell was Protector from 1653 to 1658.

Daughters of Stuart Kings.—Mary II. (daughter of James II., elected with her husband as William III. and Mary II.), 1688; Anne, sister, 1702.

House of Hanover (or *Brunswick*).—George I., great-grandson of James I., succeeded by parliamentary title, 1714; George II., son, 1727; George III., grandson, 1760; George IV., son, 1820; William IV., brother, 1830; VICTORIA, niece, 1837.

ENGLAND, NEW, in the seventeenth and eighteenth centuries, was the name of the English settlements on the eastern coast of North America north of 41° N. lat. New England was afterwards divided into New Hampshire, Massachusetts, Rhode Island, and Connecticut. Maine and Vermont, which before the revolution did not form provinces, were also considered as portions of New England.

ENGLISH CATHEDRAL ARCHITECTURE. With the exception of St. Paul's, which is not yet 200 years old, all the English cathedrals are in the Gothic style, and taken together they present the most splendid and complete view of that style to be found in any country. Particular periods or departments may be found in greater perfection in France, and others again in Germany; but England alone contains all. See GOTHIC ARCHITECTURE, NORMAN ARCHITECTURE.

Almost every cathedral is varied in plan, although the leading features, the nave and choir, are found in almost all. The plan sometimes embraces a "galilee" or chapel at the principal (western) entrance (as at Durham, Lincoln, and Ely), and always comprises the nave or main body of the church, the side aisles, which do not rise so high as the nave, and are placed on each side of the nave, sometimes with chapels between the openings formed by the windows; the choir or place for the ceremonies of the church; and the transept or division at right angles to the end of the nave next the choir, which projects on each side, and forms a cross on the plan. Some cathedrals (as Durham) have a double transept, and the transepts have often aisles. At the end of the choir is the high altar, behind which is frequently a lady chapel, or chapel to the Virgin, as at Lichfield. The choir of a cathedral is sometimes terminated by an apse or semicircular end. Along the sides of the choir are ranged richly carved seats, ornamented with arches, pinnacles, and tracery carved in oak. The bishop's seat, richer than the others and raised above them, is on one side at the eastern end. The choir has also side aisles. The minor parts of a cathedral are the muniment room, the library, the consistory court, the vestries of the dean and chapter, minstrels' chapels, a font, and a minstrels' gallery. Beneath the body of the cathedral there is usually a crypt or low basement, supported on arches springing from thick columns.

The ancient cathedrals of England display all the varieties and excellences of Gothic architecture. Like all ecclesiastical buildings, they stand with the altar towards the east, and the principal entrance to the west; the transept is placed north and south. At the point of intersection of the transept with the nave there is usually a tower, sometimes surmounted by a spire. Sometimes the principal or western front has a tower at each angle (see Plate II., York Minster), which in some instances are also terminated with spires, as at Lichfield. The nave of a Gothic cathedral is supported by clustered columns, arched from one to the other, over which there is usually a row of small arches forming a gallery, which is called the triforium, and above are windows called clerestory windows, which are the windows in that part of the nave which stands above the aisles. (See the nave of Durham Cathedral in Plate I.) The exterior walls of the cathedral and its towers, strengthened with buttresses, which are generally decorated, and surmounted with pinnacles, and between the buttresses are the openings or windows of the nave and aisles. The buttresses of the low-pitched aisles often rise, supported on an arch, to the wall of the far loftier nave: these are called flying buttresses. (See Plates, Henry VII.'s Chapel, York Cathedral.) The ceiling of the nave is sometimes of stone, and covered with tracery formed by the intersection of the arches which spring from the clustered columns of the nave. The west or principal front is usually the most highly decorated with tracery, pinnacles, and sculptured figures. In the side aisles, and the aisles of the choir, there are often richly-designed chapels. Our cathedrals abound with monuments of various epochs, from the early Norman period of our history to the present time. The chapter-house and cloister are large and important adjuncts to many of our cathedrals. The finest chapter-houses in England are of a polygonal form on the plan, with a seat running round from the entrance, and the interior decorated with sculpture, and in some instances with painting. In some chapter-houses a column, or cluster of columns, rises from the centre of the room, from which spring the sides of pointed arches, meeting the other halves of pointed arches rising from the columns at the angles of the walls.

The cloisters are rectangular inclosures, with a richly ornamented and arched gallery running round the sides, and a wall forming the back of the inclosure: the arches, which are filled with tracery, look into an area, where probably the monks were formerly buried. There are also such cloisters in some of the colleges of Oxford and Cambridge. This part of the ecclesiastical structure may have been used not only for exercise, but for study.

Many of our parish churches have very much the form of a cathedral. The chancel of a church corresponds in situation to the choir of a cathedral. In parish churches the great tower is seldom placed at the intersection of the nave and transept, but usually forms the entrance at the west end, and contains the belfry.

English cathedrals are divided into those of the *old foundation*, which are still in great part governed by the ancient statutes, in many cases dating back to the thirteenth century (Chichester, Exeter, Hereford, Lincoln, Lichfield, London, Salisbury, Wells, and York); into those which

Henry VIII. converted in 1542 from abbeys into bishops' sees (Bristol, Chester, Gloucester, Oxford, and Peterborough); and into those of which he dispersed the monasteries attached to them, and remodelled the constitution, naming them cathedrals of the *new foundation* (Canterbury, Carlisle, Durham, Ely, Norwich, Rochester, Winchester, Worcester). To these must be added those of the more recently erected sees of Liverpool, Manchester, Newcastle, Ripon, St. Albans, Southwell, Truro, and Wakefield.

The Welsh cathedrals, Bangor, Llandaff, St. Asaph's, and St. David's, and the Manx see (Sodor and Man) are all of the old foundation.

The following sketch of some of the more interesting of the cathedrals may be useful, classing them under the periods which they illustrate. But as no English cathedral, save Salisbury, belongs wholly to one period, it will be best first to trace the history of a type of the usual and more heterogeneous structures.

York Minster may serve as an excellent type of the varied fortunes of English cathedrals, for it contains specimens of every period from Saxon down to late Perpendicular. The great Edwin, king of Northumbria, on his conversion built a stone church at York, inclosing the wooden church which had witnessed his baptism. This was of course of Saxon work, and part of it remains—viz. the central part of the wall of the crypt under the choir. Edwin's church was burnt during the harrying of the north by William the Conqueror in 1069. The first Norman archbishop, Thomas of Bayeux, built a Norman church, of which, however, nothing now remains save the western walls of the existing crypt. The Norman cathedral of Thomas was replaced piecemeal. First a new Norman choir was built (1171), the crypt of which alone now remains, completing Archbishop Thomas's crypt. Then an Early English transept was substituted (1215–56), and is the oldest part of the minster now above ground. In the Decorated period the fine nave replaced that of Norman Thomas (1285–1345), and the splendid chapter-house was built. The choir now was manifestly out of keeping, and in the Perpendicular period the Norman work of Archbishop Thomas's successor gave way to a fine Perpendicular choir and lady chapel (1361–1400). The Late Perpendicular period contributes the completion of the great tower and the two western towers (1405–70).

York is the most noble of all our cathedrals. While every detail can be surpassed elsewhere, it contains more beauties perhaps than any other single church. Thus its west front is excelled by Lichfield in beauty and harmoniousness, but the latter is largely made up of cement, &c., to replace the injuries suffered by sieges from the Roundheads. Its magnificent east window (Perpendicular), 78 feet high by 33 wide, is eclipsed in size by Gloucester (72 feet by 38), but York has the original glass. An arrangement was made during the Civil War by which the minster was respected, consequently the window of York is quite unique for its large quantity of early fourteenth century painted glass, and some of the date of 1200. Here again it is excelled by Canterbury in colour and style. Further, the chapter-house at York is the most beautiful edifice of its kind, except that of Westminster. Its central tower, the core of whose walls is Norman, is the most massive (62 feet on the side) of all except Winchester (65 feet). Its vast nave must yet yield the palm to Canterbury, and the exquisitely beautiful west window, of date about 1340 (see Plate III.) has to dispute its supremacy with the larger window of Carlisle of the same Decorated period. York, running second in so many features, with the height of its noble roof and its width from wall to wall alike of about 100 feet, with its five-light lancet window in the north transept 50 feet high ("the five sisters"), and its grand internal view, and finally with the noblest Early English composition we have—the north front, shown in Plate II.—must be admitted to stand at the head of all English cathedrals. It should be added that its title of minster must not be held to mean that it was "monastery" in the usual sense. It was a foundation of secular-religious persons, the so-called Culdees of the Scoto-Irish communion, founded under Oswald, second Christian king, by Aidan of Iona, after the flight of Paulinus on the death of Edwin. This Scottish church was incorporated with the papal communion by the Synod of Whitby in 664. In 1072 York was subjected to Canterbury; in 1125 this was reversed; in 1354 it was agreed that the Archbishop of York should be called Primate of England, and his brother of Canterbury Primate of All England, which titles exist to this day.

This history of York may stand, *mutatis mutandis*, for that of the other cathedrals. York is seen to have Early English transepts, Decorated nave, and Perpendicular choir and towers. The other cathedrals may be grouped as follows among the different periods, it being remembered that each cathedral nearly always exhibits specimens of all or of most periods within itself:—

Norman Period.—*Norwich* is accepted as the finest type. Its choir, lower part of tower, and transepts date 1096–1100; the nave was added 1121–45. The spire is an addition of 1369. The Beauchamp Chapel is fine Decorated; the west front, on Norman basis, was altered to Perpendicular (1425–36), and the same was done with arches of the choir after 1500. The nave (250 feet from west door to transept) is the longest in England except St. Albans (300 feet), and its vaulting is particularly fine.

Durham has a fine Norman nave (1093–1125) up to the roof, with unusually fine piers, as shown in Plate I. The upper part of the western tower (except the tasteless modern parapet and pinnacles) is Early English, and of the central tower Perpendicular (1457–80). The Early English eastern transept (the "nine altars") and the curious projecting Late Norman Galilee porch (1153–95), are striking features at Durham. The latter has the tomb of the Venerable Bede, the choir that of St. Cuthbert, whose body, at least upon the testimony of the monks, remained uncorrupted for centuries. The doors into the cloisters from the nave at Durham are magnificently ornamented in the round-arched Norman style; one of them is given in Plate I. Many of our parish churches have Norman work remaining, and especially in the lower and protected parts—a crypt-column from Lastingham and a splendidly decorated Norman elliptical arch from Tickencote, in illustration of this, complete Plate I. The cathedral is beautifully situated on a lofty rock overhanging the winding Wear, and forms a striking group with the adjoining castle. The Bishop of Durham also was, after the Conquest, Earl of Northumbria, with plenary powers, unknown in England, except in the other County Palatine of Chester. His office was to guard England from the Scotch.

Peterborough.—The first Christian spot in Mercia (Middle England), though it was spared by Henry VIII., and raised from a Benedictine abbey to a bishopric for the sake of the tomb of Catharine of Aragon, lost all its splendid relics and all its fine painted glass at the hands of Cromwell's soldiers. The choir and part of the eastern transept of the first Norman abbot, Martin of Bec (about 1118) remain. Later Norman work is the rest of the transept and the nave (1155–93). Though so much of Peterborough is Norman, its special glory is its unrivalled Early English west front, the grandest portico in Europe, of three splendid arches 80 feet high, the centre one narrower than its companions, and the piers standing quite clear of the west wall. These two piers began to bulge, and had to be supported by a sort of porch, which fills up the lower part of the space between them. It is an elegant building in itself, in Late Decorated style, but cannot fail to be an eyesore in its present position. Within, Peterborough is specially favoured in retaining its Norman choir-apse, and

its curious painted Norman ceiling, though, this is now raised from its former flat condition to a half-octagonal shape. The central tower was so unsafe that it had to be taken down in 1883. The "new building" or retro-choir, running across the east end of the church, was rendered necessary by the wealth of relics, which needed room for exposure. It is Perpendicular of the highest beauty, with a noble fan roof; and was begun in 1438, and not finished till early in the sixteenth century.

Ely has fully as grand a Norman nave as Peterborough, and has some most remarkable and characteristic features. It is the longest Gothic cathedral in Europe, measuring 250 feet from west to east. (Milan Duomo, though not so long as Ely, covers a greater area.) The vast edifice dominates the whole of the fen country, from its imposing position on a height. It was begun by Abbot Simeon, a relative of the Conqueror's, in 1090. The transepts are Simeon's original work. The painted ceiling of the later nave, though in true Norman style, is modern. Ely became a bishopric in 1109. It was completed by 1189, including the great western tower, but this was altered in the Perpendicular period. Ely should have a complete western transept, like Peterborough and Lincoln, immediately within the west door, but the northern part of this transept has been destroyed; the southern part alone remains. The Galilee porch and the west front are Early English (1198–1215), and the choir was rebuilt in the same style (1235–52). Three bays were added in the Decorated period, of date 1345–62; these are pronounced to be the most beautiful examples of the style in the world. In 1322 Abbot Simeon's tower fell, as his brother Wakelyn's at Winchester had done long before (1107), and gave an opportunity to Alan of Walsingham to introduce the chef-d'œuvre of Gothic internal design, the unique octagon of Ely (1322–28). In all other Gothic interiors the well-like space of the central tower at the junction of the nave and transepts is of small effect, but at Ely the architect took in the mighty square of his plan the whole church to the outside of the aisles; then, cutting off the angles, he produced an octagonal addition in the Decorated style, rising vast into the air, containing full three times the area of the usual tower, and crowned by a two-storied lantern. The great space glows with light and colour, and the intricacy of outline, the wealth of pier, of arch, of window, make up an architectural view not to be surpassed for striking effect. Though therefore Ely has such fine Norman features, it is upon its Early English, and especially its Decorated portions, that its high position depends. Ely is particularly valuable, as the date of nearly all the work is precisely known.

Canterbury was rebuilt by Lanfranc, replacing the original church of St. Augustine, in 1070; and his saintly successor, Anselm, enlarged the choir. In 1174–84 the chapel of St. Thomas and the curious "corona" were added. This last fine Norman work, with an intermixture of the Early English style just then arising, exists to this day. Lanfranc's nave was rebuilt in the Decorated style in the fourteenth century. The great towers are Perpendicular, about 1490. Stained glass of the twelfth century, quite unique, still remains at Canterbury.

Early English Period.—*Salisbury* is the type and model of the Early English style. Its unrivalled spire (404 feet high) was added later, but with this exception the whole cathedral was built between 1220 and 1258, the west front being a little later. The plan is that of a double cross.

Lincoln, however, surpasses Salisbury in one sense, for though less beautiful it is a much earlier example of the style. The Norman cathedral fell by earthquake in 1185, and next year saw the choir of Lincoln begun; the nave was built 1209–35 (see Plate III. for one of the buttresses of the nave), and the famous Bishop Grossetestе completed the church by the transepts and the lower part of the central tower in 1235–53. The cloisters are of transition or Geometrical work (1280–1300), as is also the famous angel-choir, an eastern transept beyond the choir, the fine east window of which is shown in Plate III. (1272–82). The upper part of the west towers and the west windows are of fine Late Decorated work, about 1450. In situation Lincoln is the grandest of all English cathedrals; on its sovereign hill it is seen from everywhere round, its rich and varied outline amply compensating for a certain lack of elaboration in detail as compared with other churches, arising from its peculiar position as the earliest purely Gothic building in Europe. A little of the Norman work of St. Remigius (*St. Remy*, 1073–92) remains in the central part of the west front, including the main portals. This Norman portion looks all the more a patch upon the fine Early English work of the remainder, in that it is defaced by some Perpendicular windows afterwards cut into the upper portion of it, a singular piece of bad taste. The detached chapter-house, with its bold flying buttresses, is so fine as to demand mention; and the east window (57 by 34 feet) already referred to is held to be the finest of its style in England.

Lichfield, whose three spires form a delightful group to the traveller in what was the ancient Mercia, owes that exquisite harmony of its architecture, which probably entitles it to the palm of beauty, to the fact that like Salisbury it was built practically at one effort. But Lichfield, which replaced a Norman structure, was built later and took longer. It covers the thirteenth century, starting with the choir in 1200, transepts 1240, nave 1250, west front 1275, and lady chapel 1300. When Bishop Hackett took possession of his cathedral at the Restoration in 1661, he found the result of its having served as a barrack and a fortress in the roofless nave, the spire (258 feet) lying in ruins where it had crashed through the roof, and the superb west front one mass of fragments. It is to be feared that a certain architect, Wyatt, who flourished at the close of the last century, damaged poor Lichfield by his alterations even more than the Cromwellians had done by their simple breakage. The ruin effected by Wyatt in some half dozen of our cathedrals is quite unspeakable. The genius of Sir G. G. Scott in our own day has been largely occupied in annulling the work of this man. The inner view of the nave of Lichfield can hardly be exceeded for beauty, richness, and gracefulness (the curve of the arch and a pier are shown in Plate III.) The triforium is exquisitely modelled. Lichfield is so clear in plan, and so suitable as a type, that it is given in Plate II. (the dotted lines indicate the groining of the roof). The heavy piers for the two graceful western spires (183 feet) and for the imposing central tower (285 feet) are well seen. The choir, chancel, chapter-house, and vestry are evident, and clearly placed; and the radiating buttresses of the chancel, when the aim was concentrated upon getting the windows as large and the walls as slight as possible, show well their form and function.

Chichester is a fine piece of Early English architecture, erected at the close of the twelfth century to replace the original Norman cathedral of 1083. The famous tower and spire, which had been long defective, fell in 1861. It was restored by Sir G. Gilbert Scott.

Westminster Abbey must also stand as an Early English cathedral. It is doubtless known to our readers as the coronation church of all our kings since Harold, and the burial-place of our greatest men. Some remains of the Norman church of Edward the Confessor (which replaced a Saxon church of another Edward of A.D. 980) still exist in the cloister and the pyx house, south of the abbey. The present building is mainly by Henry III., begun in 1220 and completed by Edward I.; the original choir, transepts, and lady chapel being removed to make

place for that triumph of Late Decorated work, Henry VII.'s Chapel. The greater part of the nave is transitional in style. The choir is fine pure Early English. The west front is due to Henry VII., except the hideous upper towers, which serve to show what a great man could perpetrate in a style to which he was profoundly antipathetic. Bernini's "asses' ears" to the Pantheon at Rome are not more incongruous than Sir Christopher Wren's finish to the towers of the abbey. The abbey is 416 feet long, the chapel 115; the total length is therefore 531 feet. The roof is as high as that of York (102 feet); the western towers are 202 feet high.

Geometrical Period (transition).—*Hereford* gives the best examples of the transitional style called Geometrical, before the fine flowing tracery of the Decorated period had yet developed. It is a most ancient see, one of the British bishops of Hereford having been present at a synod called by the Archbishop of Caerleon in 544. It is a particularly interesting cathedral now that Sir G. G. Scott has done away with the barbarisms of the "restorer" Wyatt. It is built of old red sandstone, and is as weathered as a sea-cliff. The nave piers and the lower part of the choir are Norman, 1079–1135. The lady chapel and the clerestory are Early English, about 1260. The special glory of Hereford is its transitional north transept, with the almost triangular arch of the windows and the geometrical tracery which gives its name to the style, of date about 1300. The outer walls and windows of the nave aisles are Decorated, about 1360, and the north porch and Bishop Audley's Chantry are fine Perpendicular work of 1500–35.

Decorated Period.—*Exeter* has a west front adorned with statues, a work of wonderful intricacy and beauty in this style; indeed the chief part of its architecture is Decorated, except the quite unique and valuable Norman transeptal towers. Though not large, the beauty and richness of Exeter give it high rank.

Carlisle, though built by William Rufus and his successor, was so damaged by fire in 1292, and further ruined in the Civil War, that the remains of the Norman nave were turned into a separate church (St. Mary's). It is to be hoped that at a future time the nave may be again connected with the cathedral. The choir, built after the fire, is of Late Decorated work, and is generally held to rank first in the style in England. The red sandstone and the gold-studded blue of the roof give a fine effect to the interior. The famous east window (1363–95) exhausts the ingenuity of the critics to find epithets wherewith to express its beauty. Fergusson boldly says, "It is the most beautiful design for window tracery in the world." Its only English rivals are the west window of York, and the remarkable circular window in the south transept of Lincoln.

Bristol (originally an Augustinian abbey), which has completely lost its Norman nave, like Carlisle has a fine Decorated choir and east window, with original stained glass of 1320. The central tower is Perpendicular. Though so mutilated it is very interesting. Bristol forms part of the combined see of Gloucester and Bristol.

Worcester has a good Decorated nave (1317–27) and central tower (1374). The Norman crypt of St. Wulfstan is yet left. When the abbey was burned in 1202 so many miracles were worked by the bishop's tomb that in 1203 he was canonized, and the abbey grew rich on the gifts showered upon it. St. Egwin, St. Dunstan, St. Wulfstan were the three sainted bishops of Worcester. King John was one of its benefactors, and his tomb lies in the cathedral, surmounted by a curious contemporary effigy. Arthur, elder brother of Henry VIII., also lies at Worcester in a very fine chantry (Perpendicular).

Perpendicular Period.—*Gloucester*, which has a fine Norman nave with piers 30 feet in height, and is indeed properly a Norman work, is noticeable for the splendid Early Perpendicular architecture (1329–77) faced upon the Norman walls, especially in the choir. The earlier forms are clearly traceable. The very lovely Perpendicular cloister (1377–1412) is held to be the origin of the fan vaulting, afterwards so great a feature of the style. The tower (225 feet) is of date 1450–60, and is interesting to compare with that of Canterbury, 10 feet higher, and built nearly fifty years later. The exquisite tracery of parapets and pinnacles is the unique charm of Gloucester. The lady chapel, 1457–98, is the last fine work in the style. The great east window is the largest in England, and is even wider than the choir, for the side walls are splayed out at the eastern end in order to give room for this "wall of glass." The painted glass is the finest of the period. The wealth of Gloucester was largely derived from the tomb of Edward II., whose body, rejected by many churches for fear of Queen Isabella and Mortimer, was welcomed at Gloucester and sumptuously housed. Edward was regarded as a saint, and many pilgrimages of the faithful, together with the favour of the grateful Edward III., raised Gloucester to high rank. Robert Courthose (eldest son of the Conqueror) lies here. The famous effigy on his tomb is, however, in all probability not older than Henry II.

Winchester, the work of Wakelyn, brother of Simeon of Ely, begun in 1079, was refaced almost entirely in the Decorated style by William of Wykeham, the Norman work being wholly covered over instead of serving as a visible basis, as at Gloucester. The famous chantry is also of this period. William Rufus lies at Winchester.

Henry VII.'s Chapel, in Westminster Abbey, closes the glorious record of Gothic architecture in England in the first years of the sixteenth century.

In Plate III. the characteristic windows of the Gothic style are shown by selected types. Lincoln yields a fine example of Geometrical tracery in its great east window, York an equally fine example of Decorated in its noble west window, Taunton a very pure example of Perpendicular. The Early English arch, first of the pointed arches, as it appears in Lichfield, is contrasted with the Tudor arch, latest of the pointed arches, as it is in the finest of all Tudor (Late Perpendicular) buildings, the exquisite chapel of King's College, Cambridge. The sectional plan of Lichfield pier and of King's College door-pillar and mouldings are also given as eminently characteristic of each style. Pinnacles differ very greatly in the various styles, and form another of the great peculiarities dividing each from each: in the Plate the beautiful Early English pinnacle from Lincoln is shown as against the over elaboration of the well-known pinnacles which steady the piers of the flying buttresses of Henry VII.'s Chapel at Westminster, latest and most splendid monument (though it be not the most beautiful) of our national architecture—built almost as the first waves of the fatal Renaissance reached our shores to engulf all originality in building among us, as it would almost seem, for ever. A half elevation and section of this wonderful piece of elaborate work is given in Plate IV., the flying buttress being well shown, as well as the huge size of the great window. A plan beneath indicates the construction, the great radiating piers of the east end showing their true magnitude. The groining of the roof, with the unrivalled circular drop that forms so marked a feature in Henry VII.'s Chapel, is clearly marked—the drop itself is seen in the section above. The same splendid style as applied to domestic architecture (Tudor) is perhaps at its best in Hampton Court Palace; and the famous woodwork of the roof of the hall, with a portion of the front, showing the characteristic arch and oriel window of the style, is added therefore to Plate IV.

Modern Classical.—Plate V. shows two of Sir Christopher Wren's works in the style which arose out of the Renaissance. It is now universally conceded that all this

period was a huge mistake. Gothic buildings in Italy, and Italian buildings in England, are fatally out of place. But taking the style as it is, without regarding its suitability to climate or national temperament, it must be admitted that St. Paul's is a very noble piece of architecture. If Wren had not been hampered at every step it would have been still nobler. When it is decorated in the warm colouring and profuse gilding and mosaic work which this style imperatively needs, no doubt the interior will prove as effective as the exterior—at present it is cold and unattractive. Our section and plan on Plate V. permit the very firm structure of the "dome" to be seen. What is seen is merely the outer case or the inner case, according as it may be, of a very broad, thick, hollow spire or pyramidal tower, and the "dome of St. Paul's" structurally does not exist at all. Wren could not believe in the stability of such a structure. The result in the interior view is of course disastrous. The irresistible sense of lightness, of suspension from some invisible point, which makes the dome of St. Peter's at Rome a never-ending marvel to the beholder, however often he stands beneath its unrivalled curve, is altogether absent from St. Paul's. The trick is felt, though not one in a thousand knows that the trick is there. The same criticism holds with the narrowing of the nave, the "windows" along the side external walls being merely decorative; and the walls themselves a hollow curtain, far away from the true walls of the Cathedral nave. As was said, it is not fair to judge Wren from the work as it stands—possibly these shams of construction were due to part of the powerful pressure brought to bear upon him. The unity of design of St. Paul's externally is very pleasing, and in delightful contrast with the execrable façade which still is suffered to ruin St. Peter's. Wren had the great advantage over the Romans, of designing the whole structure. It was begun in 1675 and completed in 1710. (Wren died in 1723.) The skilful way in which he has managed to get a pyramidal outline, culminating in the lantern of the dome, from every point of view cannot be too much praised. A fair example of a smaller church of Wren's (St. Bride's, London) is shown on the same Plate, and the plans of both the cathedral and church are also given. The merit of simplicity at least is always due to this great architect.

(Murray's "Handbooks of the English Cathedrals," London, 1876, &c., give an exhaustive account of each edifice.)

ENGLISH CHANNEL, called by the French *La Manche*, is that narrow sea which separates the southern shores of England from the northern shores of France. On the W. it opens into the Atlantic Ocean by a wide mouth between the Land's End and the French island of Ushant (*Ouessant*), where it is about 100 English miles across. On the E. it is united to the North Sea by the Strait of Dover. This strait, which must be considered as a part of the channel, is formed on the English side by the shore between the South Foreland and Folkestone, and on the French side by that between the harbour of Calais and Cape Grisnez, and at its narrowest point between Folkestone and Cape Grisnez is only about 20 miles across, and at other points very little more. West of the Strait of Dover, the channel rapidly increases in width, and between Brighton and Hâvre is more than 90 miles across. Further west, however, it is narrowed by the peninsula of Cotentin, which projects from the French coast into the channel. Between the Isle of Wight and the peninsula of Cotentin the distance is hardly 70 miles. West of the peninsula is the widest part of the channel, which between St. Albans Head in Dorsetshire and the Harbour of St. Malo is nearly 140 miles across. The remainder of the channel to its junction with the Atlantic is between 100 and 110 miles wide.

ENGLISH DRAMA. See DRAMA.

ENGLISH LANGUAGE. The English language was originally formed from the languages spoken by various tribes from the north of Germany, who settled in this country in the fifth and sixth centuries. The principal of these were the Jutes, the Saxons, and the Angles. (The aboriginal Britons were driven into the mountainous parts to the west, where their language, the Welsh, continues to be spoken.) At subsequent periods the English language received various additions from the Danish, Greek, Latin, and French, to which it owes its wonderful copiousness. But dictionary English is very different from that in colloquial use, or from that of ordinary written composition. Instead of about 40,000 words there is probably no author in the language from whose works, however voluminous, so many as 10,000 words could be collected. We should be surprised to find, if we counted them, with how small a number of words we manage to express all that we have to say, either with our lips or even with the pen. Our common literary English does not probably extend to 10,000 words, our common spoken English hardly to 5000. And the proportion of native or home-grown words is undoubtedly very much greater in both the 5000 and the 10,000 than it is in the 40,000. Perhaps of the 30,000 words, or thereabouts, standing in the dictionaries that are very rarely or never used, even in writing, between 10,000 and 15,000 may be of French or Latin extraction. In our literary English, taken at 10,000 words, those that are non-Roman are found by repeated counting in various authors to be over 6000. Of 5000 words current in our spoken language about 4000 are Gothic and 1000 Roman words; but even this is fallacious in favour of the Latin (and French), for the small particles, prepositions, conjunctions, &c., recur out of all proportion to other words, and these are almost all genuinely English. In many parts of the authorized version of the Bible one may count for a long time without finding more than one word in forty which is not English in origin.

The basis of our English tongue is the Low German of the three tribes around Elbe who in the fifth century conquered Britain. These tribes called themselves *Ænglisc*, and came from an older *Ængla-land*. Their dialects were mutually intelligible, differing not nearly so much as the Yorkshire and the Somersetshire of to-day; and this common tongue, the Old English, as it is now correctly termed, is what passed up till our own day under the incorrect term Anglo-Saxon. Its court form, the language of Wessex, was the product of the Saxon tongue modified by the Anglian of the north and the Frisian of the east. But these three dialects differed, and the difference is still traceable in our provincial English. We have a large collection of prose and poetical works in this ancient form of English, or *Ænglisc* as it should be called. The principal are—the English Chronicle, the translations made or edited by King Alfred, and the homilies and writings of Abbot Ælfric in prose; in verse, the "Beowulf," a version of an old Swedish saga, the poems named after Cædmon, probably renderings of different heads of older Scripture paraphrases, like the Old Saxon Heliand; and the poems of Cynewulf in the "Codex Oxoniensis," with some others. The Norman invasion brought in French modes of thought and versification like that of the troubadours, rhyming and metrical, rather than alliterative and accentual like the Norse and Anglo-Saxon poems. And the vocabulary was enriched and altered by the introduction of French-Latin words, but the basis of the language still continued to be Low German. A period of transition and of some confusion led, through Nicholas of Guildford, Robert of Gloucester, William Langley, and others, to the culmination of a true Middle English in the grand prose of Wickliffe and the yet grander verse of Chaucer, recognized as the father of modern English literature.

The relationship of this Old English to the family of

Indo-European or Aryan tongues, of which it is a member, will best appear in a table—

ARYAN family has six branches, . . .	*Indian*, as Sanskrit.	
	Persian, as Zend.	
	Slavonic, as Russian.	
	Celtic,	Gaelic.
		Cymric.
	Græco-Latin, as Greek.	
	Gothic, as German.	

Of these the first three have hardly any effect upon English; we find the roots of our words in them, common to them and to us alike, but we have not inherited much from them. The Celtic, and especially the Cymric division of it, spoken in Cumbria, in Wales, and in Cornwall by the Britons long after the English conquest, and presumably the tongue of the ancient Britons, has left traces upon our tongue. The Græco-Latin comprises not only Greek and Latin, but all the modern (Romance) languages immediately derived from them, as Modern Greek, Italian, Spanish, French, &c. We derive the greatest part of our non-English words from this source, chiefly through France. Another table will most clearly show the position of the English language among its own immediately allied tongues. The Gothic branch has two subdivisions, namely, the Teutonic and the Scandinavian. The latter divides into ancient Icelandic and into modern Danish, Swedish, and Norse. The principal divisions of the former are:—

TEUTONIC subdivision of Gothic—three groups, .	Mæso-Gothic.	
	Low German,	Old English.
		English.
		Dutch.
		Flemish.
	High German,	Old German.
		Modern German.

Upon our Low German basis we first get a small Celtic addition from the conquered race, such as names of places (*aber*, mouth—Aberwick or Berwick, Aberbrothwick or Arbroath, &c.; *dun*, hill—the South Downs, Huntingdon, &c.; *lin*, pool—Lynn, Linlithgow, &c.; *caer*, fort—Carlisle, Carmarthen, &c.; *tre*, town—Coventry, &c.), and a few names of common objects, as basket, *basgawd;* button, *botwn*, &c. The following is an exhaustive list of the principal words:—Bard, basket, bran, breeches, button, cart, clout, coat, crook, darn, druid, flimsy, funnel, gown, gruel, gyves, happy, hog, kiln, mesh, mop, pert, prank, rail, rasher, sham, tackle. We have added in modern times direct from the Celtic—clan, flannel, kilt, plaid, reel, tartan. It seemed worth while to show the full extent of our Celtic additions that their extraordinary smallness might be an additional evidence of the unexampled ferocity of the English conquest. The native people were simply exterminated.

Latin stands for a considerable factor by itself, and still more through the French. We have—(1) the names of Roman stations, &c., all the casters and cesters, as Doncaster (*castra*, camp); the colns (*colonia*), as Lincoln; the ports, the streets: these are the oldest. Then (2) the ecclesiastical terms of the English conversion—chalice, candle, cloister, mass, minster, monk, &c. And (3) direct importations of Latin by the scholars of the Renaissance and men of science of all time. Several of these retain their Latin inflections, such as formula (pl. -æ), datum (pl. -a), radius (pl. -i), &c., but if in common use they do not. We do not use genii for geniuses, or talk of premia of insurance.

French was brought over by the Normans at the time of the Norman conquest, and even during the previous reign of the Confessor it had become the court language, as Edward had spent his youth abroad and was French rather than English in his tastes. French never superseded English with the people, but for some time it held complete mastery over the upper classes. We find that it was not till 1300 that the schools were taught in English, and not till 1362 that the courts of law heard pleas in English. In 1265 we find the language of universities and schools, of Parliament, and of literature to be Latin for the highly educated, French for ordinary folk. All our words in *-our*, *-ier*, *-eer*, *-que* (as honour, cavalier, peer, picturesque), and such terminations, or beginning with *counter-*, *pur-*, *sur-* (as counterpart, purpose, surprise), come from the French, and generally any English word originally Latin or Greek, and much altered from its original, may be assumed to be derived through the French. Examples are—manure, Fr. *main œuvre* (cultivation by hand labour), Lat. *manus opus;* blame, Fr. *blâmer*, Lat. *blasphemare*, &c.

Greek words are almost exclusively literary, introductions of churchmen and of scholars, the nouns retaining their own plurals usually, as is so often the case in imperfectly naturalized words. We say phenomena (not phenomenons), automata, dogmata, &c. But the last word is now so far an English word that one often sees dogmas used for the plural.

The last chief source of our language is the Norse element, due to our Danish conquerors, and filtering from East Anglia and Northumbria into common speech. Towns in *-by*, as Whitby, &c., the termination of names in *-son* and *-sen*, as Richardson, &c.; and a few words, about as many as those of Celtic origin, the chief of which are ale, anger, call, crop, earl, fellow, gust, hair, husband, knife, law, scrap, sky, spoil, take, ugly, want, &c., are of Danish origin.

The remainder of our words come from all kinds of quarters. The Hebrew gives us Bible terms, as ephod, cherub, seraph, &c.; the Arabic terms of secret lore, as algebra, alchemy (whence chemistry), talisman, cipher, zero, &c.; Persian sends us paradise, and several dyes, as scarlet, azure, lilac; Turkish gives us its scimitar, pasha, sultan, &c. Continuing at random, our gong is Chinese; our bantam and sago are Malay; our calico, chintz, curry, and muslin are Indian; taboo and tattoo are from the Pacific; tobacco, potato, maize, and hurricane are, as one might expect, West Indian in origin; squaw and wigwam, are North American; hammock, South American; from Italian come banditti, guerilla, pantaloon, gazette; Spanish gives us cocoa and chocolate, mosquito, negro, punctilio, and alligator; Portuguese, marmalade, caste, cocoa-nut; and Dutch, yacht, sloop, and buoy. Our limits alone stop the enumeration of these very various strangers.

Another curious group comes from names of towns, &c., as cherry (Cerasus), currant (Corinth), damson (Damascus), guinea (Guinea gold), peach (Persia, *persica*), parchment (Pergamus), spaniel (Spain), &c.

We get many *doublets* in our language, since it is made up of such numerous elements, that is words which arrive among us by two channels, as violin through the Romance, fiddle through the Gothic, which are the same word in origin. So also pin, pen; beef, cow (*bo* the Gaelic, *go* the Sanskrit form of $\sqrt{\text{GHU}}$); brother, friar; dish, desk; inch, ounce; &c. All these are identical words, altered in their diverse passage to us. The list might be indefinitely extended. Another long list (*homonyms*) arises from a similar cause—namely, those words which, from two quite distinct sources, have suffered change until by curious chance they have come to sound or to be spelt alike. This is the fruitful field for the joker and punster. Of such are the English arms (limbs) and the Latin arms (*arma*, weapons); the Latin ball (dance) and the Gothic ball (round body); the Portuguese cocoa-nut (*coco*, a mask, the "face" shown by the base of the nut) and the Spanish-Mexican cocoa-drink (*cacao*, name of a tree whence chocolate is made); the English fair (pleasing) and the Latin fair (*feria*, a holiday); the English rest (repose) and the Latin rest (remainder), &c. This is perhaps an even more interesting series than the other. A third list (*synonyms*) is the safety of orators as the second was of witlings. Here we get the same idea

expressed by words from two different languages; and with proper economy each synonym is made to do duty for a different *nuance* of the central idea. "Terrestrial" is by no means precisely the same as "earthly," though (as in the well-known passage from Corinthians used in the burial service) it may be used for elegance as its substitute. A famous example of this branch of our subject is Dr. Johnson's sudden exclamation of anger at a dull and also unseemly jest: "Sir, it has not wit enough to keep it sweet;" which, as he saw Boswell noting down the shrewd epigram, he thought to ennoble by correcting the phrase into "to preserve it from putrefaction," according to his usual habit of Latinizing the nervous English of our tongue. By help of synonyms we "answer questions in a speech" or "reply to inquiries in an oration;" a "fit of wrath" calls up an "ebullition of anger," &c. In fact a tolerably thick book, and an extremely useful one, Roget's "Thesaurus," is made up of a collection of English synonyms. As has been hinted, there are very few real synonyms, but there are many which are partly identical, and which can therefore in certain senses be exactly interchanged. On the other hand such a collection enables a writer whose phrase does not quite hit off his meaning to alter every word, if need be, until he has polished it into accuracy. Is it necessary to repeat a phrase? The practised orator does so without changing the meaning but altering every word. Or is it necessary to appear to repeat a phrase while giving it a fresh colour? Liberty of speech becomes a "license to harangue," and an acute and fluent speaker degenerates into a "sophistical and verbose rhetorician."

In one of the wittiest of English satires Defoe laughed at the "trueborn Englishman" with his mixture of races and blood; but in language, as in people, this diversity of origin has proved a source of what we fondly deem the greatest excellence in the world.

ENGLISH LITERATURE. In the article English Language the source of our literature was shown to be the language of the *West-Seaxna*, the Saxon branch of the English family, which, though far less numerous than the Angles in England, and though rising to supreme power after them, yet retained and augmented that power until they first ruled over one undivided kingdom. Thus it is that not the language of Burns but that of Shakspeare is held to be our "king's English." Had Edwin and not Egbert brought England into one land, undoubtedly the first would have prevailed.

As it is, our first English poem, and the most ancient of any Teutonic poems whatever, "Beowulf," is the tale of a Gothic hero's adventures in the land of the Danes, told in Anglian (not Wessex) speech; and the scenery, though it purports to be that of Denmark, is in every line and tint that of Whitby and the east of Yorkshire. The MS. itself is of the eighth century, but the poem may be of the fifth century, altered in the telling. [See Beowulf]. The next of our priceless English relics is the paraphrase of Cædmon, written also in Anglian English, about 670 or 680, and fully described in the article Cædmon. These and all other ancient English poems are in unrhymed verse, depending upon Alliteration for their rhyme—a style so suited to our tongue that in our own day Swinburne has worked marvels with a modification of it. It is to be hoped that a bolder reformer will copy the example of the great poet-musician Wagner, and flinging aside rhyme and syllabic-metre restore to us alliteration and the measure of accents. Bede's "Ecclesiastical History," finished in 731, is in Latin; but he translated the Gospel of John into English (again the Anglian form, of course), and completed it almost with his last breath. The tale is one of the most pathetic, and is paralleled (though unhappily not fully) by the death of Green the historian in our own day (see preface by Mrs. Green to the "Conquest of England," London, 1884); each historian, the earliest and the latest, dictating long after the hovering death had snatched away the pen. "There is yet one sentence not written, master!" "Write quickly," said the venerable Bede. Soon after the boy said, "It is finished now;" and Bede answered, "It is well; you say truly, all is finished now;" and while his scholar supported his head that he might sing the Gloria, he died as the name of the Holy Spirit passed his lips. It is the universal regret of Englishmen that that Gospel is lost.

Two other considerable bodies of very ancient English verse have come down to us. One is the "Exeter Book," given as a valuable relic by Leofric, bishop of Exeter, to his cathedral, about 1050; and the other is the "Vercelli Book," discovered in Italy in 1823. In both of these is much by Cynewulf, probably a bishop of Lindisfarn about 780; certainly of the eighth century. Three considerable poems—on St. Helena, on the martyr Juliana, and a series on Christ—thus happily exist. There are also secular tales and even riddles, as well as the productions of the cloister.

Alfred the Great gave a new direction to English literature. With a limited knowledge of Latin, it was his pleasure and his life-task to translate Bede's "Ecclesiastical History," Orosius' "Universal History," and other books, as Boethius' "De Consolatione," and a book of Gregory the Great's, from Latin into the English of Wessex. "There are only a few," said he, "on this side the Humber who can understand the divine service, or even translate a Latin letter into English: and I believe not many on the other side of the Humber either. They are so few, indeed, that I cannot remember one south of the Thames when I began to reign." Alfred added to the book of Orosius as he translated; and finally, gathering courage, he began the famous English Chronicle, which, starting with a compilation from Bede, came down to the then present time. Thus from generation to generation the English annals were written by Englishmen, till the accession of Henry II. (1154) saw the closing entry, long after every other literary trace of English had perished from the land. Of course there were before the Conquest numerous other English books, but save a few fragments and the fine old Chronicle our native literature is now almost unrepresented from Alfred to Henry III. Here we find the Anglian dialect again represented in a fine poem called the "Ormulum," due to a certain Ormin, who named it after himself—

"This boc is nemmned Ormulum,
Forthi that Orm itt wrohhte."

He was an Augustinian canon, and wrote in English that the common folk might understand. His object is to give the meaning of the church services throughout the year. That the spelling might indicate the pronunciation Ormin doubled the consonant, as in the fragment above, after every short vowel. This was doubtless a great help to the French-speaking monks of the time. Now began again Wessex to stir. Contemporary with, or even perhaps before Ormin, Layamon translated Wace's French "Brut" into English alliterative metre, and doubled it in length in the translation. The whole poem, of over 30,000 lines, contains less than fifty Norman-French words. Nicholas of Guildford gives us a bright English poem, of 1792 lines, in rhyming octosyllabic measure, on the "Owl and the Nightingale," in a contest betwen whom the poet was called in as arbiter. We also get in the same metre an English paraphrase of Genesis and Exodus, and several French romances—"King Horn," "Guy of Warwick," and the "Romance of Alexander," &c. Here also may be placed the "Sir Tristrem" of Thomas of Ercildoune in Berwick, earliest Scottish poet; famous, too, for a reputed knowledge of the black art.

About 1280, under Edward I., we get the fine English version of "The Lay of Havelok the Dane," perhaps the most brilliant specimen of our early tongue; and contemporary with it Robert of Gloucester's rhymed English Chronicle, running from the siege of Troy to the death of

Henry III. (1272); parts of it must have been written after 1297, since they speak of Louis IX. of France as St. Louis, and he was not canonized till that year. But these may have been later additions. It is a coarse piece of work, but very pure in its English. Another poem, the "Land of Cockaygne," where rivers ran with oil, milk, wine, and honey, and where geese ran about ready roasted crying "Geese all hot," and the monks, nothing loth at the invitation, fared sumptuously in perfect indolence, is amusing to this day—

"Though Paradise be merry and bright,
Cockaygne is of fairer sight."

Robert of Brunne, about 1300, produced the last of the interesting works of the first Edward's date. His "Handlynge Synne" (Handling Sin) is a translation of Bishop Grosseteste's "Manuel des Péchés," a set of anecdotes pointing the moral of infractions of the seven deadly sins, and the reward of practising the twelve graces and observing the seven sacraments. Under Edward III. the same writer translated into English Peter Langtoft's French Chronicle of England. But now, the reign of Edward III. being reached, we leave the consideration of antique English for works which any one of us can read, or ought to be able to read, with facility and assuredly with delight. Chaucer was born in 1328; Wickliffe and Langland in 1324; Gower perhaps a little later; Sir John Mandeville about 1300. While these men were young the antique form of the tongue was consolidating itself, borrowing the useful parts of Norman speech, simplifying its own grammar. Its latest examples are the interesting three sets of miracle-plays or mysteries acted by the town guilds; the twenty-four Chester plays by the monk Higden, the thirty-two Wakefield plays (or "Towneley Mysteries"), and the forty-two Coventry plays.

The change to the poems of CHAUCER (elsewhere described) is like a burst of sunlight to the student. His fine taste and his wonderful power of sketching character, joined to a command of language and an ability to make the best of both sources of our tongue never before seen, made Chaucer unknowingly the founder of our modern English language and literature. With him wrote his friend whom he styles the "moral Gower," but in a style far different. Nearer rival is the great priest, founder of the Lollards, reformer before the Reformation, the dauntless Wickliffe with his vigorous tracts and his splendid Bible (finished in 1380). "If Chaucer is father of our later English poetry," says the historian Green, "Wickliffe is father of our later English prose." Anyone who for the first time takes up a tract of Wickliffe's is astonished at the racy vigour of its style and the picturesqueness of its phraseology. Mandeville's Travels was published in 1356, a book only second to Wickliffe as fixing English prose. Contemporary with the courtly Chaucer and the earnest Wickliffe, but very different from either, is the poet of the misery of the wretched poor. Langland's "Piers Plowman" is one long wail over hunger and toil, most fascinating in its intensity, and one of the saddest poems ever written. It is our only real source of knowledge for the truly miserable state of the poor of England under Edward III. and Richard II., and affords some explanation of the peasant revolt under Jack Straw and Wat Tyler.

Succeeding this noble group we find a noteworthy circle of Scottish poets. James I., "best poet among kings, best king among poets," during his long captivity in England from 1405 to 1424, caught the English vein, and in his own style sang some fine songs, the best of them the "King's Quhair," and "Christ's Kirk of the Green." After him came William Dunbar and Gawain Douglas, whose works are described elsewhere; and the circle was closed by him of whom Scott sings in "Marmion"—

"Sir David Lindsay of the Mount,
Lord Lyon King-at-arms."

Malory's "Morte d'Arthur" was one of the first English books printed by Caxton (about 1485), and will always have additional interest from having inspired Tennyson with his life-work, the "Idyls of the King." It was a collection of the legends of the semi-mythical British king Arthur. Caxton himself was a diligent and worthy contributor to English literature. More's "Utopia" is another epoch-making book, perhaps less directly useful, however, than his "Life and Reign of Edward V.," written in 1513, as valuable as a record as it is charming as a book, and a great advance in style upon anything before. More had succeeded Wolsey as chancellor, and a curious and amusing set of poems in jingling rhyme still remains to show the detestation of the "butcher's son of Ipswich," his predecessor. These are the "Why come ye not to court," ("which court, the King's court or Hampton court?") and the "Colin Clout" of John Skelton, poet-laureate of Henry VII., and formerly tutor to Prince Henry (Henry VIII.) The bold versifier poured out his vigorous invective from the shelter of the sanctuary of Westminster, or his life had no doubt paid for his temerity. He died in 1529, the year before the great chancellor fell.

Wickliffe's Lollardry was bearing fruit elsewhere than with brave John Skelton, and the next era is an era of translations and sermons. In 1526 appeared Tyndal's English New Testament, in 1530 his Pentateuch; in 1535 Coverdale's Bible, in 1537 "Matthew's" Bible (by Rogers), in 1539 Cranmer's or "the Great" Bible. (The Authorized Version, or King James's Bible, appeared in 1611, and the Revised Version in our own day—the New Testament in 1881, the Old Testament later.) By 1550 Latimer was preaching his deathless sermons, which were destined to "light such a candle by God's grace in England as shall never be put out," as he cried to his fellow-martyr Ridley at the stake when he was burned in 1555. John Foxe's "Book of Martyrs," written almost at the time of the Marian persecution, which it so scathingly records, is known to all readers by quotations such as the above of Latimer. It is a remarkable book, insomuch that the fierce light thrown upon the unhappy Mary has blinded us altogether to the fearful persecutions of both Henry VIII. against all who denied the *royal supremacy*, Roman Catholics or Protestants alike, and of Elizabeth against the Roman Catholics, more political than religious in its motives, and embracing indeed in a less degree the Puritans.

The blaze of grandeur which marks the Elizabethan literature of England follows. To name "Old Ascham," the queen's schoolmaster, is to name "one of the freshest, truest spirits one has met with; a scholar and a writer, yet a genuine man," as Thomas Carlyle says. Wyatt and Surrey mark the rise of Italian influence, the one the beginner of the sonnet, the other the first to write blank verse. Spenser, the poet of poets, blesses all posterity with the shadowy dreamland of the "Faërie Queen," and gives to versifiers the model of a stanza unrivalled for certain effects. Thomson, Burns ("Cottar's Saturday Night"), Campbell, Scott, Byron, Wordsworth, Shelley, Keats, all have produced some of their best works in the Spenserian stanza. Sidney's splendid "Arcadia" was written in 1580, "one of the greatest monuments of the abuse of intellectual power upon record," as Hazlitt rather exaggeratedly, but not without truth, condemns it. His sonnets are treasured by all; who does not know and love that beginning—

"With how sad steps, O moon, thou climb'st the skies."

Hooker's "Ecclesiastical Polity" sins like Sidney's "Arcadia," and indeed much of the Elizabethan work, by over-gorgeousness of style; but it is a magnificent book notwithstanding. Then Raleigh's "History of the World," with its almost unequalled conclusion, the apostrophe to "eloquent, just, and mighty death," which has "drawn

together all the far-stretched greatness, all the pride, cruelty, and ambition of man, and covered it all over with these two narrow words *Hic jacet*." What a noble fragment it is! One notable characteristic of the Elizabethans was their daring enterprise. Witness these colossal fragments of Raleigh and Spenser, for the "Faërie Queen" is but the smaller part of the projected work. Lyly's "Euphues," like More's "Utopia," has given a word (euphuistic) to our language. His stilted style and affected conceits are quizzed rather unmercifully by Shakspeare in "Love's Labour Lost," and by Sir Walter Scott in the "Monastery."

Lyly brings us to the plays, for he too was author of no less than nine. English tragedy begins with Sackville's "Gorboduc" (1562), and English comedy with Udall's "Ralph Roister Doister" (1566). Marlowe struck a new chord, and as with Chaucer, so with him, one seems at a bound to have come into a new horizon. The progress of the English drama has been elsewhere sketched [see DRAMA]; and the brilliant circle of Greene, Peele, Chapman, Ben Jonson, and Beaumont and Fletcher, surrounding the glory of the whole world of drama, our greatest and best, SHAKSPEARE, need therefore but be named here.

Succeeding the Elizabethan is an era of less splendour, but yielding possibly a more general enjoyment and profit. Milton was the only poet of the highest eminence who flourished in it; but he by common consent stands next to Shakspeare. First among the writers of James and Charles' time stands the great Lord Bacon, whose delightful "Essays" we venture to say are known to far more of our readers than his "Advancement of Learning" or his "History of Henry VII." Fuller's "Worthies" is one of the best beloved books in our language, witty, quaint, ingenious, and never dull. One regrets, almost as if the mischance had happened to a personal friend, that he was not permitted to live to receive the bishopric which awaited him at the Restoration. The earnestness which is lacking in Fuller, his only fault, is richly made up in the noble strains of Jeremy Taylor, supreme among our theologians. "Holy Living and Holy Dying" entitles him to the epithet lovingly bestowed on him, of the "Shakspeare of English prose," as it abounds in sublime description and touching grace and tenderness. Other books of this time, dear to us all, are the charmingly quaint "Compleat Angler" of Master Izaak Walton, which appeared in 1653, Sir Thomas Browne's "Religio Medici," and his still finer work on urn burial ("Hydriotaphia"), so rapturously admired as "absolutely beautiful" by Carlyle. Hyde's "History of the Rebellion" (1707), abominably faulty in style and prejudiced in temper, is yet a fascinating book; and its portraits are almost unequalled. The style of the "Philosopher of Malmesbury," Thomas Hobbes, once the secretary of Lord Bacon, but afterwards the author of "Leviathan" (1651), is admirable for the work it had to do—short, clear, precise, and pithy. Wonderful to relate for a philosopher, he is invariably intelligible.

The poets of the Restoration, save Milton and Dryden, are now remembered only by a few charming poems. Lovelace's "Althæa," Sir John Suckling's "Wedding," some of Herbert's religious lyrics, and Herrick's songs, are very delightful. Just before and in this era also occurs the curious group of "metaphysical" poets, full of strained phrases and "witty conceits," children of Lyly's "Euphues" and of Sidney's "Arcadia" in some measure. They are Donne, Cowley, Denham, and Waller. But Cowley's essays are fine prose, and some of Waller's songs are almost unique.

The next step should be into the foul quagmire of the comic drama of the Restoration, as it is called, wherein Dryden, Mrs. Aphra Behn, Wycherley, Congreve, Farquhar, and Vanbrugh wallow, the almost unbreathable air hardly stirred by any waft of fine feeling. The style was borrowed from France, had French fancy and wit but accompanied the king from his exile! But this, as also the history of the last struggle of tragedy to regain the proud throne it had filled under Elizabeth and James, by help of Dryden, Davenant, Otway, Rowe, and Lee, has been elsewhere recounted. [See DRAMA and also DRYDEN, &c.] We may pass on, therefore, to the prose of Charles II.'s time.

The age was full of plots and counterplots, and literature bent itself to the various parties. On the royalist side the glorious Dryden, now at last in his element; and Butler's long sarcasm against the Puritans in doggerel verse (the well-known "Hudibras") has given us many couplets of undying excellence, and in its own time was keenly relished from cover to cover. But now, while all men quote some twenty or thirty verses, few are found who have read the entire poem, and those few confess it to be tedious to modern minds. On the other side Burnet's "History of his own Times" is extremely amusing as well as valuable, while his "History of the Reformation" (1679) was thought such a blow from the Puritan ranks as to call forth the thanks of a Puritan House of Commons. The Quaker Baxter's "Autobiography" was strong on the same side, with the immortal "Pilgrim's Progress," Bunyan's prison work, and the "Alarm to the Unconverted" of Alleyn, who died in gaol from over-punishment. Richard Baxter's "Saints' Rest" and Bunyan's "Pilgrim's Progress" are works, too, that can never die as long as our present English is spoken; the language of absolute truth here speaks out in a way which charms and touches the heart of every one. Probably the "Pilgrim's Progress" has, as Froude claims, affected the spiritual opinions of English-speaking folk more than any other book save the Bible. Locke's philosophical works, such as the "Essay on the Human Understanding" (1689), mark the transition to a new and more wholesome time. Both the diarists of this time, Pepys and Evelyn, are weary of the rottenness of the court of Charles.

The so-called "Augustan age" of our literature, from some fancied analogy to the times of Horace and Virgil, or the "age of Anne," is a welcome relief from the Restoration era. This is the age of the ESSAY (elsewhere treated in detail), begun by Steele, and continued and perfected by Addison; of brilliant political writing, by Temple, Swift, Bolingbroke, and Defoe—respectable in drama with Addison's "Cato," and in philosophy with Berkeley's works; glorious in poetry with the never-equalled versification of Pope (for though few are deeply moved by that poet, all are compelled to admire his consummate art); delightfully amusing with the letters of Lady Mary Wortley Montague, of Pope, and of Walpole; fascinating with Defoe's "Robinson Crusoe" and "Colonel Jack," and with Swift's "Tale of a Tub" and "Gulliver's Travels;" sweetened and purified by the hymns of Wesley and Cowper. Pope died in 1744; the sceptre of literature passed to Samuel Johnson, and under him the brilliancy changed to solid worth, perhaps not for the worse. To Dr. Johnson is due the preeminent service of freeing our literature from the shackles of the great. Practically all the men hitherto named, except Langland and Defoe, were either themselves of the aristocracy or were dependent upon it. In one sense Pope also may be added to the list. But Johnson it was who first maintained, and with success, the dignity of letters as a profession. Dryden had been thrashed, Defoe had been pilloried, Swift exiled, Butler starved; Johnson was the first who lived honestly by honest literary work. There is no one who cares much for Johnson's ponderous style now, but there is also no one who does not admire the learned author of the "English Dictionary," so poor that at the close of his great work he had to go to prison for a debt of £6, and few who do not respect and almost love his veracious old age. Boswell's "Life of Johnson," though a book almost without literary merit, is as faithful as a photograph, and still retains for us its interest unabated. Goldsmith's poems, comedies, and above all his "Vicar of Wakefield,"

surpass the "Ramblers" and "Rasselas," the "London" and "Irene" of his ponderous friend in the fancy of to-day. With Goldsmith and Johnson were associated Reynolds the painter, Garrick the Shakspearian actor, and Burke the statesman, in a sort of club, a very choice circle of genuine friends, all men of genius. It may be questioned whether the speeches of the latter have ever been surpassed. Passages of Edmund Burke once read never leave the mind; of such are his "age of chivalry is gone," his description of the terrible French Revolution, &c. At this time, too, the elder Pitt delivered those splendid orations which have unfortunately been too scantily reported. Gray, Collins, Young, Allan Ramsay, Thomson, Chatterton, and Cowper wrote poetry which, especially that of the first and last, is still food for the readers of to-day. Burns, who died in 1796, lives and will live in our very hearts. Adam Smith in 1776 founded the science of political economy with his wonderful "Wealth of Nations," excellent in style and lucid in arrangement. Following hard on Burke in his oration at the trial of Warren Hastings, and eclipsing Goldsmith with his "Rivals" and "The School for Scandal," Sheridan, as profligate as he was witty and versatile, threw away a genius which ought to have done more for our literature. This was an age of philosophy, illustrated by men like Hume, Hartley, Priestley, Reid, and Dugald Stewart; and three great histories we also owe to it—Hume's "History of England," Robertson's "Charles V.," &c., and Gibbon's "Decline and Fall of the Roman Empire." With such grave works may be mentioned the ever-fresh "Analogy of Religion to the Constitution and Course of Nature" (1736) by Bishop Butler, a very storehouse of allusions and quotations. The great novelists, Richardson, Fielding, and Smollett, with the lesser lights of Sterne and Madame D'Arblay, &c., form a prominent feature, showing a most healthy tone in this "Augustan" period.

The classical style of Pope, Addison, and Goldsmith could no longer exist when the whole civilized world was thrown into tumult by the French Revolution of 1789. The early poems of Coleridge and Southey, the whole life of Byron and Shelley were aflame with it; even the calm Wordsworth spent 1792 in France becoming acquainted with the Girondist chiefs. Burns, a government official, got into terrible trouble for shipping arms to the Convention. Thus flashed upon our literature almost like a lightning-stroke a new era. "Childe Harold" and "Don Juan" revealed a side of the poetic feeling unthought of before, and superseded at once the pleasing *chevaleresque* poetry of Scott, which had gained the public ear. The world was no loser by this, for the elder poet cheerfully acknowledged the greatness of the new star and his inability to rival his fire, and himself, turning to a new sphere, began that immortal series of Waverley novels which have delighted and still delight with their healthy adventure and gallant chivalrous feeling all classes of our countrymen. But as France settled down, and it was found that after all the world had not been turned upside down, Southey and Coleridge relinquished their projected communistic scheme of a "pantisocracy" to be founded on the banks of the Susquehanna, and with Wordsworth poured forth from their retreat among the Cumberland lakes that beautiful collection of verse which Byron in vain attempted to ridicule out of existence as the "Lake School." Coleridge's "Ancient Mariner," and Wordsworth's sonnets, lyrics, and larger pieces are enjoyed by thousands to-day, while the intense and brutal egotism of the greater poet steadily reduces the number of his admirers. Other poets of this later reaction are Campbell and Crabbe; and the luscious verse of Keats is also a special glory of the time.

The writers of the present day have fallen on evil times. Never was science so daring and speculation so rife; the steam engine has raised colossal fortunes in its train, materialism and atheism rear their heads unabashed, nothing is sacred, wholesale state confiscation of property is calmly discussed as if an ordinary piece of legislation—what has literature to do in such times? Tennyson takes refuge in an attempt at an English epic; Browning analyses emotions of men of all ages and countries save his own, making but few exceptions to this rule; Carlyle and Ruskin set their faces steadily towards the past, Matthew Arnold lives in the classic world, William Morris in the ancient mythology; Mrs. Browning and Swinburne almost alone attempt the problems of the age, and fail in the attempt. The poetry of the steam engine has still to be evolved. But that this age, though not directly poetical, is an age of vaster possibilities than ever loomed before is abundantly shown by the unequalled speculations in philosophy of Mill, Spencer, and Bain; by the fairy-land of science revealed by Darwin, Tyndall, and Huxley; by the revolution effected in astronomy, chemistry, &c.; or by the rise of a new geology, a new biology, a new sociology, &c., each with its numerous eloquent masters and disciples. Literature is shifting its ground, possibly taking up higher ground—we who live during the process cannot be the judges, but we would fain hope so.

Meanwhile, as might be expected of an unpoetical, practical, many-sided life like the present, it is an age of novels. Jane Austen, Charlotte Bronte, George Eliot are pre-eminent and have countless minor followers (*longo intervallo*) of their own sex; Lytton, Thackeray, Dickens, Kingsley, Black, Trollope, Wilkie Collins, George Meredith, and Shorthouse are among the greatest male novelists, and from America come Poe, Hawthorn, and James. At least if we sometimes think we fall beneath our fathers in the quality of our literature, the quantity and variety are such as never before was dreamt of. The number of contemporary newspapers, magazines, &c., is prodigious, and huge circulating libraries scarcely supply the voracious maw of an all-reading society.

ENGRAILED, a style of border in heraldry, indented with semicircles.

ENGRAVING, the art of executing designs by incision on plates of copper, steel, wood, or other substance, for ornament or for obtaining therefrom impressions or prints upon paper or wax, &c. See also CAMEO, DIE-SINKING.

From the book of Exodus we learn that when Moses had liberated the Jews from Egyptian bondage, he was commanded to "make a plate of pure gold, and grave upon it, like the engravings of a signet, Holiness to the Lord." He was also commanded "to take two onyx stones, and grave on them the names of the children of Israel, according to their birth; with the work of an engraver in stone, like the engravings of a signet." Both these passages distinctly imply the practice of gem and seal engraving, and also of engraving on metal plates. From Herodotus (v. 49) we learn that one of the earliest uses to which engraving was applied among the Greeks was the delineation of maps on metal plates. Some of the Egyptian hieroglyphic inscriptions are evidently executed with instruments similar to those now in use. Some of the lines narrowing downwards have clearly been cut with the lozenge-shaped graver now chiefly used; but other lines, being of the same width through their whole depth, must have been produced with that species of graver called a scooper, still used for effecting broad incisions. It is believed that some of the relics of Etruscan art in the British Museum are of as high antiquity as any existing specimens of engraving. In India, also, the art of engraving on plates of copper appears to have been practised long before the Christian era. It would appear that it was there customary to ratify grants of land by deeds of transfer actually engraven on plates of copper, as we now write them on skins of parchment.

In England, before the Conquest, many of the buckles, clasps, rings, and military accoutrements were engraved. In the Museum of Oxford is preserved a finely engraved gold jewel, which belonged to Alfred the Great. About the twelfth century was introduced the art of engraving sepulchral brasses. They are executed entirely with the graver, and in the same manner that a copperplate is now engraved.

We now approach the period when the invention of *printing* gave to engraving a new direction. The first prints were obtained from engraved wood blocks. The earliest with a date attached to it is one known as the St. Christopher, dated 1423. No impression from an engraved *plate* has been found with a date anterior to 1440, when the art was first practised by Tommaso Finiguerra, a Florentine goldsmith. Many of the Italian goldsmiths were *niellatori*, or workers in *niello*—a mode of ornamental engraving usually performed on silver plates—the design engraved on which was afterwards filled in with a black composition. The practice of trying his work by taking an impression from the engraved design with ink on moistened paper suggested the art of engraving pictures to Finiguerra. When once established, the new art was eagerly taken up by Baldini, Botticelli, Pollajuoli, and Mantegna; and in Germany by Martin Schoengauer, Israel van Mecheln, and Wohlgemuth. The first *book* printed at *Rome* (an edition of Ptolemy's Geography) was illustrated by the first *plate engravings*, twenty-seven in number, which were maps, and were executed there by two Germans, Sweynheym and Buckink. This work is dated 1478, but was commenced in 1472. Another early work was an edition of Dante's "Inferno," published at Florence in 1481, and embellished with engravings by Baccio Baldini, after the designs of Botticelli.

One of the best engravers in Italy in the early part of the sixteenth century was Marc Antonio Raimondi, who studied under Francia and Raphael. His great merit lay in the correctness and beauty of his outline. He engraved many of Raphael's pictures. He was succeeded in Italy by Agostino de Musis, Marco da Ravenna, Caraglio, Giulio Bonasone, and Enea Vico, all pupils of Marc Antonio; Giorgio Ghisi of Mantua, and his relatives Diana and Adam Ghisi, Cornelius Cort, &c. The principal painters who have practised engraving in Italy are Agostino Carracci, Spagnoletto, Guercino, Salvator Rosa, Claude Lorraine, Canaletto, Piranesi, &c.

In Germany engraving made more rapid strides towards excellence in the mechanical parts of it; and at the commencement of the sixteenth century appeared Albrecht Dürer, a man whose universality of talent extended the boundaries of every department of art, and carried all to a degree of perfection previously unknown in that country. [See Dürer.] He had great command of the graver, and carried his plates to a much higher degree of finish than his Italian contemporaries. He is also believed to have invented the art of etching by corrosion; three of his specimens are dated 1515, 1516, and 1518 respectively. On examining the etchings of Albrecht Dürer we see that they have all been corroded at one biting-in which sufficiently explains their monotonous appearance, and proves that "stopping-out" was not then understood. The principal German engravers after Dürer are Aldegraf, the Bœhms, the Colferts, Solis, &c.

Lucas Jacobs, best known by the name of Lucas van Leyden, was the father of the Dutch and Flemish schools, and the contemporary and friend, almost the equal, of Albrecht Dürer. After Van Leyden the art was maintained in the Low Countries by the Wierinxes, the Sadelers, and many more, whose works are multifarious and embrace every class of subject. To mention the painters of this school from whose hands we also have etchings would be to name nearly all the most eminent painters belonging to it; Rembrandt, Vandyck, Berghem, Cuyp, Ruysdael, Ostade, Vandervelde, with many others. Of these Rembrandt is equalled only by Dürer as an etcher, if indeed by him. The marvellous productions of his needle are the delight of every connoisseur.

In France engraving has been practised with pre-eminent success in the departments of history and portraiture. The celebrity of the school dates from the time of Louis XIV. The family of the Audrans produced six eminent engravers; but of these the most distinguished was Gerard Audran, who was the first engraver who successfully united, to any extent, the use of the graver and etching-point. Gerard Edelinck, although born at Antwerp, may be fairly considered of the French school, and was an engraver of the highest order. In portrait Nanteuil is no less celebrated than his contemporaries. The Drevets, John Louis Roulett, Le Clerc, Simoneau, Chereau Cochin, Dupuis, Beauvais, Balechou, Le Bas, John George Wille, are among the best of the other French engravers.

The English school of engraving dates only from about the middle of the eighteenth century, previous to which those who practised the art in England were chiefly foreigners.

Hogarth engraved practically all his own pictures in a fine bold style, well suiting the subjects and their coarse free humour. Sir Robert Strange excelled in portrait engraving; Woollet in landscape. Mezzotint, although not strictly born among us, has been in no other country practised with a degree of success at all approaching that attained by M'Ardell, Earlom, Smith, Valentine, Green, and others in England in the eighteenth century. Bartolozzi, Ryland, Sharpe, Paul Sandby, Middiman, Milton, Fitler, and Raimbach are among the most eminent of deceased line engravers.

Engravings for the production of impressions on paper are divided into two wholly distinct classes—plate engraving (usually called copperplate) and wood engraving. In the first of these the lines intended to print are incised on the plate of copper or steel, which is subsequently entirely coated with a very stiff ink, which is then removed from the face of the plate by wiping it first with a cloth and then polishing it with the hand itself. The incised lines alone retain the ink which filled them, and when a piece of damp paper is laid on the face of the plate, and the whole passed through a cylinder press provided with a thick and soft blanket, the paper adheres to and lifts the ink from the lines of the engraving, giving the most perfect impression which has yet been attained by any printing process. It will be perceived, however, that this process is very slow, and as it demands great skill in the printing, costly.

It was early perceived that if an engraving could be produced *in relief*, like a printing type, it might be printed in the same way as type, by simply inking the surface and pressing the paper on it by suitable mechanism. This is the object of the system of *wood engraving*, in which the design is first drawn on the surface of a smooth block of box or other close-grained wood (cut so that the fibres run at right angles to the surface). All the surface is then removed by the engraver except those portions which are to appear in black. Printing ink, a stiff substance somewhat like oil colour, being applied to the surface with an elastic roller, adheres only to these raised lines, the quantity on the surface of the roller being too small to fill up the hollows cut by the graver, and an impression is then printed on paper in the same way as from a page of type.

In practice many precautions have to be taken in printing wood engravings, which shall be noticed under the article Printing, but the above account will sufficiently explain the principles on which is based an art that has attained a remarkable degree of perfection in our own day.

In its earlier developments, however, the results obtained by this process were so rude that, though the older of the

two, it was almost entirely neglected in favour of the various modifications of *copperplate engraving*, which at once attained, in the hands of the Italian line engravers, perhaps the highest degree of perfection it has ever reached.

This process includes the five distinct styles—line engraving, etching, aquatint, mezzotint, and stipple. *Line engraving* is the oldest of these. The principal instrument employed is the *graver* or *burin*, which is usually of the form of a quadrangular prism, fitted into a short handle. The square graver is used in cutting broad lines, and the lozenge-shaped for more delicate ones. In making the incision it is pushed forward in the direction of the line required, being held by the handle at an angle very slightly inclined to the plane of the copper or steel plate. An instrument called a *scraper* is required to scrape off the barb or burr which is formed by the action of the graver and dry point. A roll of cloth dipped in oil, called the *rubber*, is also used to make the surface smooth. The *burnisher* is used to polish the plate and to erase any scratches which it may accidentally receive, and also to make lighter any part of the work which may have been made too dark. The *dry point* does not, like the graver, cut the copper clean out, but throws it up on each side of the line produced by its progress through the metal, producing a burr which is often allowed to remain. As above mentioned, the finest works of the early engravers were produced in this way. It is, however, obvious that a great amount of careful and delicate manual labour was required to cut every line of which an engraving consists, and to reduce it the process of *etching* was invented, which consists in biting out by chemical means the portions of the plate from which a protective varnish or *ground* has been removed by the *etching-needle*. These instruments are nearly similar in appearance to sewing-needles, but fixed into handles 4 or 5 inches long; some are made of an oval form, to produce broader lines. The etching ground is a substance composed of wax, asphaltum, gum mastic, resin, &c., incorporated by melting over a fire, and capable of resisting the action of nitric acid; it is applied by the aid of heat, so as to lie in a thin stratum on the copper. To transfer the design to the copper an outline is made with a blacklead pencil or red chalk on a piece of paper, and laid with the face downwards on the etching-ground; the whole is then passed through a rolling press, the effect of which is to transfer an impression of the outline to the prepared ground. After this the design is executed with the etching-needles, which remove the ground from the copper wherever they pass, and expose it to the action of the acid during the process of biting-in. The nitric acid continues on the plate until the fainter parts are supposed to be corroded sufficiently deep; after which it is poured off, the plate washed with water, and left to dry. The parts which are bitten-in enough are now covered with what is called *stopping-ground*, which is a mixture of lampblack and Venice turpentine; this is applied with a camel-hair pencil, and allowed to dry. After this the acid is again poured on, and this process of *stopping-out* and *biting-in* is repeated till the darkest parts are sufficiently corroded. Modern line engravings are produced by a combination of the two processes above described. The principal parts of the engraving are first executed with the etching-needle, and bitten in once or twice until nearly the requisite force is obtained. The graver is then brought into use to clear and deepen the lines whereon that may appear necessary. Where very fine parellel lines are required, as in skies, &c., a machine is generally employed, which rules them with a diamond point before the biting takes place.

Etching as practised by artists, however, is a very different process, and may be defined as the superaddition of the chemical process of corrosion to a *drawing* produced on the plate direct with the etching-needle in place of a pencil. In this way every touch of the artist is reproduced in the print without the intervention of any other mind or hand as an interpreter of his meaning. Etchings from a skilful hand have therefore a high value as works of art, and have of late years rapidly risen in public esteem. It is perhaps unfortunate that the artist is somewhat hampered by the necessity of having to make his drawing *reversed* as regards right and left if he wishes it to appear in its natural position in the print. Considerable skill is required both in the management of the needle and in the biting-in, which latter part of the process may, however, be conducted by a professional engraver; but in the main the process resembles drawing, inasmuch as each stroke of the etching-needle appears as a black line in the print. The printing of etchings requires unusual skill on the printer's part. In many cases the ink is not wholly removed from the face of the plate, a smear or stain being permitted to remain on certain parts to heighten the effect of the drawing. The dry point is sometimes made use of, and the burr produced by it allowed to remain as adding to the effect of the line. It is obvious that comparatively few impressions in the highest state of perfection can be obtained from each plate, as they suffer much from the wear of printing.

Aquatint (a compound of two Latin words, *aqua*, water, and *tinctus*, stained) is an imitation of water-colour or India-ink drawings. The inventor, a German artist named Le Prince, was born at Metz in 1723. His method was to sift black resin over a clean copper plate; the resin was fixed by a moderate heat sufficient to make the dust adhere without fluxing or becoming an even varnish: he thus formed a granulated surface on the plate, usually called a *ground*, which suffered little from the action of the diluted acid, yet allowed it to corrode freely in the small spaces left between the grains of the resin. Mrs. Catherine Prestel, also a German, improved much upon the meagre works of Le Prince, and executed several large works with so much success that little more was found wanting than a ground that would adhere better to the plate and yield a greater number of impressions; this was effected by dissolving the resin in alcohol, and then pouring the mixture over the plate, the quantity of resin determining the coarseness or fineness of the grain. The design intended to be engraved is transferred to the ground from a pencil or red chalk outline in the same way as for etching. A border or wall of wax (formed of Burgundy pitch, bees'-wax, and sweet-oil), about an inch in depth, is then placed round the margin of the plate. The completion of the design is resumed by stopping out the highest lights on the edges of clouds, water, &c., with varnish. The plate is now covered with the diluted nitric acid until it is corroded to a sufficient extent to represent the lightest shadows. These are then stopped out with varnish, generally of a different colour from that first used, and the process of biting-in repeated. Then the stopping-out is carried a stage further, until finally the deepest shadows have attained their proper depth. The acid should be strengthened a very little after each application. A proof is then taken, and the plate finished with the burnisher, previously filling the whole plate with powdered white lead, by which it can be seen how much has been burnished down.

Mezzotint.—There has been much controversy as to the inventor of this kind of engraving. It has generally been ascribed to Prince Rupert, but the real author was Louis von Siegen, a lieutenant-colonel in the service of the Landgrave of Hesse-Cassel, from whom Prince Rupert learned the secret, and brought it with him to England when he came over a second time in the suite of Charles II. Some curious and very rare prints purchased on the Continent, and now deposited in the British Museum, have placed the claims of Von Siegen beyond doubt. In this style of engraving the surface of the plate is first indented or hacked all over by the action of an instrument something like a chisel, with a toothed or serrated edge, called a *cradle*, or

mezzotint *grounder*. The barb or roughness thus produced retains the printing-ink, and if in this state of preparation an impression were taken from the plate upon paper it would be uniformly of a deep colour.

The mezzotint ground having been laid the business of the engraver properly commences. Having traced or drawn with a pencil or other instrument his outline upon the plate (unless indeed, as is sometimes the case, this should have been etched by the ordinary process previous to the mezzotint ground having been laid), he proceeds to cut away the nap or ground, in conformity with the design, from all those parts which are not intended to be perfectly black in the impression. The instruments required for this purpose are *scrapers* and *burnishers*. With the former he scrapes away more and more of the ground in proportion to the brightness of the light, and the burnishers are used to produce perfect whiteness where it is required, as the high lights on the forehead or tip of the nose, or white linen in a portrait, &c. As the work proceeds it may be blackened with ink, applied with a printer's ball or otherwise, to ascertain the effect, after which the scraping may be again proceeded with, the engraver taking care always to commence where the strongest lights are intended to appear.

The leading difference between this and all other modes of engraving consists in the fact that while the process in each of these is invariably from light to dark, in mezzotint it is from dark to light; and even the very deepest shades are produced, as we have seen, before the design is commenced. Both aquatint and mezzotint have been comparatively little practised of late years, the general adoption of lithography and its superior advantages for this style of work having displaced them.

Stipple engraving resembles line engraving in this, that the work is done by the graver alone, unaided by chemical means, but in place of lines the effects of light and shade are produced by a great number of small dots, usually arranged in clusters. It is admirably adapted for the representation of sculpture or for the flesh in portraits, as it gives a softer effect than line engraving, and is generally confined to these two classes of subjects.

Wood engraving is the art of producing raised surfaces, by excision, on blocks of wood, from which impressions can be transferred by means of a coloured pigment to paper or any other suitable medium, and generally applied to pictorial representations of objects.

The Egyptians seem to have made a close approximation to printing in their wooden stamps, used for impressing characters on clay or other ductile material, and printing from engraved wood blocks has been practised by the Chinese probably from the tenth century.

In Europe the first application of the art took place in Germany, though the place is not exactly ascertained, but it is supposed to have been near Nürnberg, about the close of the fourteenth or beginning of the fifteenth century. It was probably first employed in the production of playing-cards, the outlines of which were formed by impressions from woodcuts, and the colouring filled up by hand.

The oldest woodcut with a date known to be in existence is of 1423. It represents St. Christopher carrying our Saviour on his shoulders across a river. It is by no means certain, however, that this print is the most ancient specimen we possess, as there are several others which, from their greater rudeness, have been held to have superior claims to antiquity.

The art made rapid progress. The next great step was the production of block books and the adoption of movable letters; and without entering into the disputed question of the dates of the "Biblia Pauperum," the "Historia Virginis," the "Speculum Salvationis," and others, they sufficiently prove the extension of its use, and many of the early books with movable types were illustrated with pictorial woodcuts. Maps also were engraved on wood. In an edition of Ptolemy, printed in 1482 at Ulm, there are twenty-seven; and in a later edition, printed at Venice in 1511, the outline, with the mountains and rivers, is in wood, while the names are printed with type and in two colours, no doubt by separate workings. In 1486 the improvement known as "cross-hatching," by which the bold and free effect of a pen drawing was endeavoured to be attained, was shown in Breydenach's "Travels," printed at Mainz. This invention has been usually attributed to Michael Wohlgemuth, the master of Albrecht Dürer. [See DÜRER.] Seven years later appeared the "Nürnberg Chronicle," also said to be by Wohlgemuth, but who probably only furnished the designs. Their execution is in a very superior style to that of any existing contemporary production. Two fac-simile specimens are given in Jackson's "History and Practice of Wood Engraving."

The art had now attained an excellence which induced artists of celebrity and talent to select it as the means of conveying their designs to the world. Among the most distinguished in this line was Albrecht Dürer, whose productions as a painter and an engraver on copper and wood are so numerous as to excite a doubt whether he was actually the wood engraver himself, or whether he only put the designs on the blocks, leaving them for other hands to execute.

In the early part of the sixteenth century several artists of celebrity were either designers on wood or engravers. Books also at this period were profusely illustrated. The art was chiefly practised in Germany, where it was patronized by the Emperor Maximilian, for whom Burgkmair produced the great work called "The Triumphs of Maximilian." The next great name in the annals of wood engraving is that of Hans Holbein [see HOLBEIN], whose "Dance of Death" was printed at Lyons in 1538, though Bartsch and Jackson deny that he engraved on wood, and Mr. Douce even questions his having been the designer. From about 1545 to 1580 wood engraving continued to be much used for illustrating books, in England chiefly by John Daye. From this period there is little to be recorded of essential importance till the appearance of Bewick, to whom the revival of wood engraving is chiefly to be attributed.

Bewick's best works were his "British Quadrupeds" and "British Birds" (1804), the last of which was reprinted in the year 1867, with impressions of the original cuts. They are remarkable for their fidelity, expression, and artistic feeling. His most eminent pupils were Clennel, Nisbet, and William Harvey, the latter of whom was equally skilful with the pencil and the burin. John Thomson and Robert Branston are also names to be remembered with respect. A great impetus was given to the practice and popularity of the art in England by the establishment of the *Illustrated London News*, which introduced to the public some admirable engravers, as Samuel Williams, W. Jackson, W. Thomas, and W. J. Linton, and as artists principally drawing for the wood, John Gilbert, Birket Foster, R. P. Leitch, and S. Read; and wood engraving has now attained, in the hands of the principal engravers, a remarkable degree of excellence, and has popularized the best designs of Millais, Maclise, Sir J. Gilbert, Birket Foster, Pinwell, Small, Houghton, Harrison Weir, Wolf, and others. A glance at any of the illustrated works issued by the leading publishing firms of London and Edinburgh, or in France and the United States, will show what great improvements have been effected in this delightful art within the last century.

The wood used by engravers is boxwood, on account of its close grain and firm texture; it is principally imported from Turkey. Having been made very smooth on the surface, and squared to a suitable size, it is covered with a preparation of water-colour Chinese white. The subject is then drawn in the usual way, the tints being washed in with India ink.

The tools employed by the engraver are *gravers*, *tint-tools*, and *scoopers*, or cutting-out tools, arranged in different sizes. With the gravers the outline, trees, foregrounds, and all the bolder details are cut; the tints, by which the proper *colours* or light and shade are obtained, can best be rendered with tint-tools; the parts not required to be printed are hollowed out with the scoopers. The reader will, of course, understand that all the blanks or white parts of an engraving have been cut away in the block.

The engraving being completed, the surface of the block is inked very lightly with printing ink, and a piece of India paper being laid upon it, an impression is taken by rubbing the paper with an instrument called a *burnisher* until it is fully printed. From this proof the engraver can judge whether any alterations are required, and what improvements can be effected.

Typographic Etching and Photo-mechanical Engraving.—It is not surprising that attempts should have been made to adapt some of the chemical processes above described to the production of blocks for "surface printing" in the manner of a woodcut. But the difficulty lay in this, that the *lines* of the intended engraving must be protected from the action of the corrosive liquid, and those parts intended to print white attacked by it. After many unsuccessful attempts the principal difficulties have been so far overcome that not only pen-and-ink sketches, maps, and other designs executed in line can be reproduced in this way, but even drawings in chalk, giving much of the effect of a good lithographic drawing.

The general principle on which the various processes for this purpose are based may be described as follows:—

The design to be copied is either drawn direct in a fatty ink on the surface of a metal (generally zinc) plate, or is transferred on to it in the manner explained in the article LITHOGRAPHY. It may also be photographed, either to reduce or enlarge it, from the original, and transferred to the zinc, as described under PHOTOGRAPHY. The surface of the zinc having been prepared as for zincography, when it is damped the lines of the drawing can be coated with a protective covering of very stiff ink from a roller, and the surface of the plate is then submitted to the action of the acid (or made the anode in an electro-depositing vat: see ELECTRO-CHEMISTRY). By this means a certain relief is obtained, but the action cannot be carried very far, for fear of the finer lines being attacked from the *sides* or "underbitten," as it is called. This is guarded against by again rolling up the block with a stiff ink or varnish, adapted to melt on being heated. The plate is then warmed (as usual in copperplate printing), and the melting varnish runs down the sides of the now raised lines, thus protecting them from the action of the acid. This process may be repeated several times, but it is generally advisable to complete the lowering of the larger blank spaces by tools, as the finer lines are apt to suffer, in spite of all precautions, if the etching is carried very far.

By this process blocks can be reproduced from an artist's drawing in a marvellously short space of time, as has been frequently exemplified in our illustrated papers, and they have the further advantage of being exact facsimiles of these drawings if they have been transferred to the metal plate by photography or the transfer process.

In the annexed Plate we give examples of four of the different styles of engraving, namely, line engraving, etching, as preliminary to the production of a line engraving, mezzotint, and aquatint. The various interesting but somewhat complicated processes for photo-mechanical engraving will be described under PHOTOGRAPHY. Wood-engraving is too well known to require special examples.

ENHARMON'IC, in music, is the term said to be used to describe a change of name without a change of note. Thus a change from D♭ to C♯ is an enharmonic inflexion. But strictly, on voices, violins, horns, &c, there is in this sense no such thing as an enharmonic change; for, as is shown in TEMPERAMENT, C♯ and D♭ are not the same note, but quite different notes, if only the music be truly in tune, and it is merely the exigences of the organ and pianoforte which have brought about such a confusion in musical language. Enharmonic inflexions, then, accurately speaking, are those small adjustments less than chromatic inflexions required to pass from any note to one the nearest possible to it in pitch in a new key. If we modulate from C to D, we can do so by substituting C♯, a note in the key of D, for D♭, a note a little above it, but which is in the key of C, and not in D at all. The two notes being represented by one on the pianoforte, the change is in that instrument one of name and writing only, but it is not so with voices and such instruments as have a perfect command over the intonation of their scales.

The ancient Greek enharmonic scale was a variety of the chromatic. Taking the diatonic Greek Hypodorian scale, our scale of A minor with a minor Seventh, the octave lyre would have its eight strings thus tuned—

A B C D E F G A.

To convert this to ancient chromatic the strings of the fourth and seventh notes were lowered and made to take the place of semitones above the third and sixth, thus—

A B C C♯ E F F♯ A.

This will be found, if C and F are disregarded, to give the well-known "Scotch scale," or scale of the five black notes of the pianoforte. If, however, instead of lowering the fourth and seventh strings halfway down to the third and sixth, the ancient Greek lowered them altogether to that note, he obtained the following scale—

A B C C E F F A.

This was readily converted to the enharmonic by slightly lowering the useless (original) third and sixth strings by a quarter-tone, to serve as grace notes before the third and sixth proper. Such grace notes may be heard—a sort of graceful whine—in the Arab music of to-day; and violinists too (and some singers) delight in a modification of the same effect, which they call a "mordant." The ancient enharmonic scale (in Hypodorian, or A) stood thus therefore, representing quarter-tones by the Greek asper (ʽ)—

A B ʽC E ʽF A.

Aristotle says that gentlemen of his day preferred choruses in the enharmonic genus (vocal music of course, omitting the grace-notes or quarter-tones of the lyre), as being the easiest of any to sing.

ENIG'MA (Gr. *ainigma*), a term for what is commonly called a riddle. It is the description of a thing by certain of its qualities, selected and disposed with the object of hiding what the thing is, and of occasioning its discovery to come as a surprise. The object of a direct statement is to convey information; that of an enigma is to exercise the ingenuity. The former, in its simplest and most legitimate form, has only to be *received* by the mind; the latter demands to be *solved*. The term was probably used originally to describe any short composition, such as an apologue or fable, or other portable sample of wisdom or entertainment. Enigma is something *dark* and *obscure*, and the corresponding verb (*ainittesthai*) always means to speak *enigmatically*, according to our meaning of the word, or to speak with a certain degree of mystery and obscurity. Byron's enigma on the letter H is usually considered the finest specimen of this kind of puzzle:—

"'Twas whispered in *h*eaven, 'twas muttered in *h*ell,
And ec*h*o caught faintly the sound as it fell," &c.

ENLIST'MENT, in law, the act of entering into the military or naval service. In this country enlistment is entirely voluntary. No person enlisting is allowed to be sworn before a magistrate in less than twenty-four hours after enlistment, and he is then permitted to withdraw upon returning any bounty money he has received, and paying, in addition, 21*s.* costs. See ARMY.

EN'NIS, until 1885 a parliamentary borough of Ireland, in county Clare, of which it is the county town, on the south bank of the Fergus, about 8 miles above the village of Clare, and 154 from Dublin by the Great Southern and Western Railway. Ennis is an ancient town, the chief part of which lies huddled together in narrow streets close to the river. It has, however, been much improved and several new buildings erected. The court-house, county prison, county infirmary, fever hospital, union workhouse, market-house, public library, and some handsome banks are the chief public buildings. The Protestant Episcopal church was formed out of the ruins of a Franciscan abbey, founded in 1240. The Roman Catholic chapel is large, and is considered the cathedral of Killaloe diocese. There are meeting-houses of Presbyterians and Methodists, and endowed and national schools. A county lunatic asylum is near the town. A very large statue of Daniel O'Connell, by Cahill, was inaugurated in 1863. There are four bridges over the Fergus. Agricultural produce is brought to Ennis, whence it is forwarded by lighters for shipment to Clare. There are some large flour mills, but no manufactures of importance. The assizes for the county are held in the town, and also quarter and petty sessions. Until the Redistribution Act of 1885 Ennis returned one member to Parliament. The population in 1881 was 6307.

ENNISCOR'THY, a market-town of Ireland, in the county of, and 14 miles N. by W. from Wexford by railway, is situated on both sides of the Slaney, at the head of its tide navigation. Barges of considerable size come up from Wexford with coals, timber, &c., and return with agricultural produce. There are two quays, and a bridge over the river. The more ancient and principal part of the town stands on the side of a steep hill, the houses rising irregularly above each other. The principal buildings are a court-house, market-house, handsome church, large modern Roman Catholic chapel, built from the designs of Pugin, a convent, and meeting-houses for Quakers and Methodists. It has some breweries, tanneries, flour mills, and numerous corn stores. There is a large trade in corn and other agricultural produce. The centre of the town is clean and orderly, and has many respectable houses, but the suburbs consist of poor cabins. The scenery in the vicinity is beautiful. The strong Norman castle, to which the place owes its existence, is still entire, though it was originally erected about the end of the twelfth century. At one period it belonged to Spenser the poet, to whom it was granted by Queen Elizabeth. Enniscorthy was captured by the rebels in 1798, but they were finally defeated at Vinegar Hill, about 12 miles distant, and many of them were executed in retaliation for the atrocities they had committed in the town of Wexford. The population in 1881 was 5666.

ENNISKIL'LEN, an assize town, and until 1885 a parliamentary borough of Ireland, is beautifully situated in county Fermanagh, on an island in the narrow channel which connects the upper and lower lakes of Lough Erne, 101 miles N.W. from Dublin. It is connected with Londonderry and Dundalk by railway. The town contains a county court-house, and has a handsome parish church, Roman Catholic chapel, a Presbyterian and two Methodist meeting-houses. It has also a linen-hall, a union workhouse, two barracks, a savings bank, and three national schools. In the vicinity is the royal school of Portora, founded by Charles I., and liberally endowed. The town has a good retail trade, a considerable corn-market, and a small manufacture of leather. Timber, coals, and other articles are conveyed by barges from Belleek, a small town at the foot of the lower lake, to Enniskillen, and a small steamer runs between it and the Ulster Canal, which connects the upper lake with Lough Neagh. Enniskillen returns one member to Parliament. The population in 1881 was 5712, and the number of electors 420. From its position the possession of Enniskillen has always been of importance in Irish contests. It distinguished itself during the war of 1689 by its attachment to the liberal side, and by its resisting and defeating a superior force sent to reduce it by James II. Part of the brave defenders of Enniskillen were subsequently formed into a regiment of cavalry, which still retains the name of the Enniskillen Dragoons.

EN'NIUS, one of the first of the Latin poets, and held in such esteem among the Romans that the fastidious Cicero calls him "our greatest poet" (*summus poeta noster*), was born in Calabria, B.C. 239. He was therefore younger than Plautus and Nævius. Calabria was indeed by origin a Greek and not an Italian population, and possibly it was through this that the Latin art, beginning in earnest with Ennius, a Greek by birth, took Greek art so exclusively for its models. Ennius served in the army, and his genius was discovered by Cato, his commander in Sardinia. Cato at once brought him to Rome. Here he gained much notice, and was preceptor to many young Roman nobles, and on terms of intimacy with their parents. Scipio Africanus and Titus Flamininus, the first citizens of Rome, were close friends of Ennius. It is much to be regretted that few fragments of Ennius are left; but a poet who invented Latin hexameters and prosodial verse, whom Virgil avowedly copied, and whom Horace called "the second Homer" (*alter Homerus*), must have been a remarkable man. His great work was an epic poem on the history of Rome, a very large part of which was occupied with what is described to us as a magnificent account of Hannibal's career. Ennius wrote many tragedies, chiefly translations from the Greek of Euripides, and was fertile in epigrams, and in a curious mocking verse founded on the ancient *Satura*, or accented native Oscan verse. For the strong accents of his rugged predecessor Nævius, Ennius substituted hexameters on the Greek model, but still keeping the variety of treatment and the mocking vein; and thus he created the *satire*. Excepting his elder contemporary Plautus, Ennius remains the oldest readable Latin writer; we must always remember this, and the great reverence for ancestors which formed a part of the Roman character, in estimating what the fragments would seem to us to indicate as an exaggerated opinion of the merits of this poet on the part of the writers of the Augustan age. The fragments of Ennius are best collected in the Amsterdam edition of 1707.

E'NOCH, THE BOOK OF, is one of those Hebrew Scriptures which, with the Book of Wisdom, the Books of Tobit, Judith, Maccabees, and several others, were designated apocryphal. During the apostolic age the Book of Enoch was commonly read by Jews and Christians. St. Jude, in his catholic epistle, cites it as the work of a divine prophet ("Enoch the seventh from Adam prophesied, saying," &c., ver. 14, 15); so Tertullian ("De Idolatria") refers it to the inspiration of the Holy Spirit; however, in another treatise ("De Cultu Fœminarum") he states that by some it was not received. Irenæus, Jerome, and other Fathers respectfully notice it, though not as canonical; and Origen ("Contra Celsum," lib. v.) observes that in his time it was not of great authority in the churches. It was extant among Christian writers until the eighth century, when it appears to have been lost. Several fragments, however, remained, which, with a few citations collected from the Fathers and succeeding writers, supplied the only data for the critical discussions of scholars during several centuries. There

was, however, a tradition current that the book had been preserved entire in Abyssinia, and this proved to be correct, for in 1773 Bruce brought with him on his return from Egypt three complete and beautiful MSS. of the book in the Ethiopic language. One of these he presented to the Bibliothèque du Roi at Paris, and another to the Bodleian Library at Oxford. The translation had evidently been made from the Greek some time during the fourth century, but the Greek version itself was a translation from the original Hebrew (Aramaic).

In its present form the book consists of six parts, containing in succession an account of the fall of the angels; of a journey of Enoch in company with an angel through the earth and lower heaven; revelations of heaven and the world of spirits; an explanation of the movements of the heavenly bodies and the course of the seasons; a vision of the kingdoms of the earth and the setting up of the kingdom of Messiah; and finally, an account of the signs which attended the birth of Noah, and a series of exhortations addressed to the children of Enoch founded upon the former part of the book.

An English translation of this book was published by Dr. Lawrence, professor of Hebrew at Oxford, in 1821, and he also published the Ethiopic version in 1838. A later edition, obtained by collating five manuscripts, was published by Dr. A. Dillman in 1851, and two years later he published a German translation with an introduction and commentary.

ENROL'MENT is the registering, recording, or entering a deed, judgment, recognizance, acknowledgment, &c., in the Chancery, or any other of the superior or inferior courts being a court of record. The enrolling of a deed makes it a deed recorded. Various statutes have directed instruments to be enrolled, as the 27 Henry VIII. c. 16, relating to deeds of bargain and sale of freehold land; and the 53 George III. c. 141, relating to memorials of annuities, &c. All deeds also relating to property in the counties of York and Middlesex are registered in the registry-offices there established by statute. Under the statute of mortmain all deeds containing gifts of any interest in land to charitable purposes must be enrolled one year previous to the death of the donor, otherwise they become null and void.

ENSIGN. See BANNER.

EN'SILAGE (Fr. *silo*, a pit) is a process of storing the various grasses and other crops while green, and preserving them in this condition for consumption by cattle during the winter months. Its utility proceeds upon the assumption that the nearer farmers can make their winter feeding approach to the condition of summer grazing the better it will be for the health of their stock, and the more they may be expected to thrive. It claims also the advantage of dispensing with all anxiety about making hay while the sun shines, as the grasses, &c., may be stored during any weather, wet being rather an advantage than otherwise. The system is said to be not so much a new idea as one of the lost arts which has been improved and adapted to the requirements of modern civilization—the process being seemingly as old as the hills, though as a practice of modern farming one of quite recent adoption. Green food, grass, and even leaves, such as those of the mulberry, have been stored, salted, and preserved in many countries, notably in Hungary and in the Steppes of Russia, for all the years of this century; and it is believed that Virgil refers to the process. It is, however, within the past few years that ensilage has been done on a large scale, and it was at the Château Burtin, in the department Loire-et-Cher, that M. Goffart, in 1874, pitted Indian corn in a cheap and satisfactory manner. From time to time French agriculturists paid their visits of inspection, and some few followed the example, but the practice did not become general; and it was reserved for Americans to take up the "new fashion" with enthusiasm, to build immense silos, write a book about it, and assert to the world that ensilage was the best winter food for stock, and especially for milch cows. Animals prefer, when they can choose, green keep to any food, and doubtless the health of cattle is improved when a proportion of fresh provender is given them.

Ensilage may be defined in a few words as simply the placing of green herbage in a pit, which is termed a silo, and in such position and circumstances as will first get rid of and permanently exclude the destroying and corroding oxygen of the atmosphere. The silo is made either above or below the ground, or partly in and partly out of the ground. It ought to be as far as possible air and water-tight, and must be so constructed as to admit of great superincumbent pressure on the contents of the silo, this pressure being absolutely necessary to get rid of the inclosed air. The silo is intended for the storage and preservation of green forage, which may be either wet or dry, and if properly constructed it allows of the least possible change in substance of that which is packed in it. The object of its construction is to supply the stock-feeder and dairy farmer with nutritious food for his stock, which can be secured independently of the state of the weather, and be convenient of access at all seasons.

M. Goffart, to whom we have already referred, was the first to publish a work on the subject, and an English translation of it was brought out in America in 1879. The system was at once widely adopted in the state of New York, and in 1882 an ensilage conference was held, at which samples of stored forage were exhibited, chiefly maize, clover, rye, and various grasses. Some of those present suggested the propriety of ensilaging nitrogenous fodder, such as rye and clover together, in order that cattle might be fed on the product without grain. Others recommended that pease, oats, maize, and vetches might also be ensilaged together. Every one of those who attended the congress was convinced that the practice of ensilage would enormously increase the stock-bearing power of the land.

Subsequently Mr. Loring, United States minister of agriculture, addressed a circular containing a number of practical questions to those who were known to have adopted the practice of ensilage. The replies were all highly favourable to the system, some of them affording remarkable testimony to its value. Ensilage, it was said, gave a vigour and healthy appearance not seen in hay-fed cattle. Milk and butter was made in winter as well as in summer, while stock was kept at half the expense of dry fodder. The cost of feeding on ensilage as against hay, roots, and meal was stated to be as one to three. Colonel Holcot said that he was able by ensilage to keep four times the number of cows on the same acreage that he had been able to keep when he gave his animals green food in summer and hay in winter.

It is agreed by the best authorities that the land of the United Kingdom does not produce one-half of what it is capable if properly cultivated, and with the best grass-producing climate in the world it is not a little humiliating that we should be so largely dependent on America and other countries for our beef, mutton, pork, cheese, and butter. Large as are our importations of these items, competition from foreign sources can never be so fierce with them as in the case of grain; and the best hope of the British farmer for the future would appear, therefore, to consist in reducing the area of his land under grain crops, and correspondingly increasing the production of stock. There seems little doubt that in the course of such a process ensilage would prove to be to the farmer a boon of almost incalculable value. The anxiety, expense, and difficulty which haymaking involves in our uncertain climate, especially in the case of late meadow hay, are all swept away by a process which not only renders the farmer perfectly independent of the weather, but actually makes wet weather

at the usual time for haymaking rather welcome than otherwise, inasmuch as grasses in a state of damp and wet are then in best condition for the silo. Not only so, but a forage is thus provided which cattle prefer to hay, and upon which also they thrive vastly better.

The cost of building silos is an important one in connection with the ensilage question. It would seem at first sight that the cost of erecting a concrete or brick tank in which to compress and preserve green fodder could not amount to very much; but as a matter of fact it is more than most farmers care to undertake, except with the certainty of its proving remunerative. There is one way, however, in which the worth of ensilage may be found by a comparatively inexpensive experiment; namely, by the earth-silo. It may consist of a trench 6 feet deep and of any dimensions required. The green stuff is placed in this pit, covered with a layer of roofing felt, and then with earth, so as to force the mass down with the necessary pressure. Such rough and ready silos have been tried with success, especially when care has been taken to put on enough pressure to exclude the air—a condition absolutely necessary in the case of any silo whatever. If in this way the farmer proves for himself the value of ensilage, it will not then be difficult for him to calculate which is the best —the precarious, and, if modern hay-driers be adopted, expensive method of making hay, or the new system of storing green fodder in a properly constructed galvanized iron, brick, or concrete silo.

("Ensilage in America: its Prospects in English Agriculture," by Professor Thorold Rogers, M.P., London, 1883; "Ensilage: its Origin, History, and Practice," by Henry Woods, Norwich and London, 1883; "Ensilage, a System for the Preservation of Forage Plants and Grasses," London, 1883.)

ENSTATITE, a mineral entering largely into the constitution of some so-called basic rocks. It crystallizes in the rhombic system, has a hardness of 5·5 and specific gravity of about 3·2, and varies in colour from white to green. In composition it is silicate of magnesia ($MgOSiO_2$), but more or less of the magnesia is generally replaced by protoxide of iron. When the amount of iron protoxide is considerable (5 to 12 per cent.), a distinct variety, bronzite, is recognized, receiving its name from its bronze-like lustre. It is found in many places, especially in Moravia, the Harz Mountains, the Pyrenees, and near the Lizard. The mineral has also been found in meteorites.

ENTAB'LATURE, that which in classical architecture is supported by the column. It is divided into three parts; the *architrave*, a beam-like member, resting immediately on the capital of the column; the *frieze*, a vertical surface, often decorated with leaf ornaments, or panelled by "triglyphs," and the panels filled with figures, sometimes forming a long procession (as at the Parthenon); and the *cornice*, a projecting moulding or series of mouldings, crowning the whole structure and considerably overhanging the other members.

ENTAIL'. This term, applied to estates in land, properly signifies a limited succession, one in which, owing to the will of the maker of the entail, the ordinary legal course of succession is cut off, and the settlement of the land is caused to devolve upon a particular heir or series of heirs. Such a method of dealing with estates was known in ancient Greece, but the earliest definite legal forms of entail that can be found are such as appear under the later laws of Rome. In England entails were known in Saxon times, before the establishment of the feudal system, but among the Saxons the law of primogeniture was not recognized. The feudal law favoured male heirs, and required that one heir only should succeed, so that estates began to be settled upon a particular series of heirs, as to a man and the heirs male of his body. Originally when such a gift of land was made and the donee had no heirs male of his body, or if after a male child was born no alienation was made, the land reverted to the donor on the failure of heirs male of the donee's body. The gift was a conditional fee or a gift subject to a condition, but the right of reversion was constantly evaded by a sale and repurchase on the birth of an heir, the law considering the condition purified when an heir was born, so that the donee was free to alienate the estate. The Statute of Westminster the Second, 13 Edward I. c. 1, called the statute De Donis Conditionalibus, enacted that the will of the donor should be observed, and that the land should go to the heirs specified if there were any, or if none, should revert to the donor. This statute also, though it did not directly take away the power of alienation, forbade the issue being disinherited by such alienation. It also gave the donor an estate in reversion, for the conditional fee was changed by this statute into a limited or particular estate. This particular estate was called an *estate tail*, from the French *tailler*, to cut, the particular estate being considered a portion of the fee. Legal ingenuity, however, soon discovered a mode of enabling the owner of an estate tail to cut off the entail, as it was called, and to acquire the fee, by a fine or a recovery. By this process, a fictitious action at law entailing considerable expense, a tenant in tail could bar the entail and convert the estate into a fee simple.

By the Fines and Recoveries Act, 3 & 4 Will. IV. c. 74, these legal technicalities were abolished and the execution of a deed and its enrolment in the Court of Chancery were substituted. By this simple method a tenant in tail, in possession, may now bar the entail (at least so long as there is a possibility of issue) and obtain the fee simple, thus defeating the claims of his own issue and of all persons having an interest in the estate in remainder or reversion.

The idea which prevails in many country districts as to the existence of *heir land*, *i.e.* land that must of necessity perpetually descend from father to son, is not based upon law, but only upon custom. In reality where estates are kept in one family for generations it is by means of settlements, which are renewed from time to time for that purpose. With the exception of such estates tail as are granted by the crown as a reward for public services, land cannot be legally tied up for a longer period than the lives of persons in existence and a period of twenty-one years thereafter.

In Scotland entails or tailzies properly so called received legislative sanction for the first time by the Act of 1685 c. 22, and when duly passed and registered secured the descent of a heritable estate to the series of heirs mentioned therein. Until 1848 no power to disentail existed unless it could be shown that the deed was defective in some of the statutory requirements. In that year was passed the Rutherford Act, 11 & 12 Vict. c. 36, and this was followed by 16 & 17 Vict. c. 94, 31 & 32 Vict. c. 84, 38 & 39 Vict. c. 61, and 45 & 46 Vict. c. 53.

The effect of these Acts may be stated briefly thus:— As regards all entails dated on or after 1st August, 1848, the heir in possession, if born after the date of the entail, may acquire the fee simple by recording an instrument of disentail under authority of the Court of Session; if born before the date of the entail he may disentail with consent of the heir-apparent, provided such heir-apparent was born after the date of the entail. As regards entails dated before 1st August, 1848, the heir in possession may disentail without any consent, if born on or after the above date, or if the only heir of entail alive; if born before that date, and the heir-apparent was born after it, he may disentail with consent of the latter. In any case he may disentail with consent of the then heir next in succession, or of the nearest heir, each of whom would be heir-apparent. In addition to this it is provided by the 45 & 46 Vict. c. 53, that heirs in possession under entails dated on or after 1st August, 1848, may disentail with the same

consent as heirs under entails executed prior to that date. Besides these powers, heirs in possession are empowered by various Acts to sell in payment of entailer's debts, to charge improvements, to make family provisions, and generally to exercise many of the powers of one holding in fee simple. Practically in Scotland entails are now little better than destinations, and their total abolition would probably be advantageous to all concerned.

EN'TASIS (Gr., a stretching), a term of Greek architecture to denote the slightly swelling curve given to columns to prevent them from looking hollow in the middle, as straight pillars are apt to do, at the same time giving a little increase of strength just where it is needed. The amount of the entasis in Greek columns was the subject of the most careful calculation among their architects. The columns of the Parthenon (Doric) have shafts, exclusive of the capital, 34 feet high; their diameter at the foot is 6·15 feet, tapering to 4·81 feet at the top. The outline of the column has a convex deviation or entasis of ¾ inch from the straight line. So also the columns were made to lean a little inwards at top, and the architraves in long temples were made a little convex that the temple might not seem top heavy, or the roof seem to droop.

ENTEL'LUS. See HOONUMAN.

ENTERI'TIS is the name given to an inflammation of the intestines. It may be general, affecting the whole length of the intestine, including the stomach; or local, affecting a certain part of the alimentary canal only; and it may involve in its influence not only the tissue of the mucous membrane, but also the muscular and peritoneal coat. The symptoms of this disease are found to vary according to the extent and severity of the affection, and also according to the part implicated. Thus when the gut is affected in its lower portions diarrhœa is generally present, but if the inflammation affects the higher part of the canal there may be constipation of an obstinate character. There are generally much pain and tenderness of the abdomen, considerable fever, great prostration of strength, and in some cases persistent vomiting. Among the causes of this affection the presence of irritating substances taken as food, exposure to cold, mechanical obstruction, wounds of the bowels, and the inflammation of neighbouring parts are the most common. Children during the period of dentition are peculiarly subject to enteritis, and this disease constitutes one of the most important causes of infant mortality. Treatment consists in the removal of any irritating substance, where possible, by means of aperients or enemata, abstinence from food for a time sufficient to rest the bowels, the maintenance of uniform warmth in bed, the use of warm poultices or fomentations to relieve the pain, and the administration of such drugs as tend to relieve pain and exercise a soothing influence, as bismuth, opium, &c. As this disease always leaves the patient very liable to a second attack, great care must be paid to diet for a long time afterwards, and warm clothing and a flannel belt should be worn to prevent a chill.

ENTEROPNEUS'TA is a division of the animal kingdom formed for the reception of a single genus, Balanoglossus, being a class of Vermes for Gegenbaur and a distinct subkingdom (or *phylum*) for Ray Lankester. It has a very complex branchial apparatus; the alimentary canal is separated by two longitudinal folds into an upper respiratory chamber and a lower alimentary chamber, both in free communication with each other. The vascular system is complex. See VERMES.

ENTOMOL'OGY, that branch of science which deals with insects. The term *entomology* literally signifies a discourse upon insects, it being derived from the two Greek words *entomon*, and *logos*, a discourse. The term *entoma* was first applied to these animals by Aristotle, and is synonymous with the Latin word *insecta* (whence is derived the English name *insects*), both having reference to a striking character exhibited in the insect tribe, that of having the body *insected*, or, as it were, cut and divided into numerous segments. Aristotle's term *entoma* included the Crustacea, Arachnida, Myriapoda, and Insecta (in the modern significance), and was thus co-extensive with the modern Arthropoda. Linnæus rejected the Crustacea and Arachnida from his Insecta, but retained the Myriapoda. The name Hexapoda has recently been proposed for the restricted class Insecta. See INSECTS.

ENTOMOPH'ILOUS FLOWERS are those which are cross-fertilized by the agency of insects, while those in which the pollen is borne from one flower to another by the aid of wind are called *anemophilous*. In order to attract insects they are generally rendered conspicuous in some way, by being brightly coloured, or in night-blooming flowers by being white, by being placed several together as in heads or umbels, sometimes with the flowers round the circumference irregularly developed, or again by the plants growing in a gregarious manner. But besides attracting the attention of insects by being conspicuous, many have sweet scents, and induce insects to visit them for the sake of the honey, while others, like the Rafflesia, have the very disagreeable odour of putrid meat. The pollen itself is an attraction as well as the honey. Irregular flowers, as Darwin has pointed out, are almost always fertilized by insects; and it is inferred that flowers have gradually been modified through the visits of insects, and moreover that certain insects have been modified, *pari passu*, through constantly visiting the same species of a flower.

ENTOMOS'TRACA is a large division of the class CRUSTACEA. The limits of this group are somewhat uncertain. It may be divided into the following orders: —Copepoda, Ostracoda, Cladocera, Phyllopoda, Xiphura, Trilobita, Eurypterida. To these are sometimes added the Cirripedia and the Epizoa, which are considered as Entomostraca whose structure has been modified by parasitic habits. The last three orders, extinct with the exception of Xiphura, present an agreement in many respects with SCORPIONS (Scorpiodea), and have accordingly been removed to the Arachnida. The Entomostraca are for the most part extremely small crustaceans, but are very numerous. The carapace is formed of one or two pieces, which either completely or in great part cover the body of the animal. In some it approaches in appearance so nearly to the form of a bivalve shell, that a person who did not examine with a microscope the animal contained within would not hesitate at first to call it so. These creatures are carnivorous, and are very useful in clearing stagnant waters of putrid animal matter. Their branchiæ are attached either to the limbs or mouth appendages. They are preyed upon by larger animals, and form the food of some of our most esteemed fishes. Some of them are parasitic, being fixed upon the bodies of fishes and other animals that live in the water. Many undergo a series of changes, amounting to a species of metamorphosis, in their progress from youth to maturity. All the typical Entomostraca hatch in the Nauplius condition, with three pair of appendages, all foliaceous, and the second and third pair branched. They are numerous in fresh water, and many are marine, those inhabiting the ocean assisting materially in producing the luminousness of "the world of waters." The most typical and probably the earliest order of this group is the Phyllopoda. In this order the appendages to a great extent retain the foliaceous and biramous character of the Nauplius throughout life. Three appendages are modified as masticatory organs. At least ten pairs of locomotive limbs follow these; in Apus the first two pairs of locomotive appendages are jointed, the rest are simple and unjointed, and by a mere vegetative repetition of parts are excessively multiplied, some sixty pairs of these limbs being developed. The two pair of antennæ are small. The branchiæ are attached to the

feet. The carapace when present is either large and shield-shaped, as in Apus and Lepidurus, or bivalve, as in Estheria. Chirocephalus has no carapace. Parthenogenesis occurs in Apus, the males of which are exceedingly rare, and were till recently unknown. This order is represented in the Plates devoted to the CRUSTACEA by *Lepidurus prolongus*, and *Chirocephalus* (Branchipus) *stagnalis* (Plate I., figs. 7, 8). The order Cladocera, often ranked as a suborder of the Phyllopoda, have the body, with the exception of the head, inclosed in a bivalve carapace. The two pair of antennæ are converted into club-like swimming organs, the second pair being by far the largest. They have from four to six foliaceous branchial limbs. In some, as the genus DAPHNIA, parthenogenesis occurs. There is a single large eye. The Cladocera (CRUSTACEA, Plate I., figs. 5, 6) abound in fresh water. The Ostracoda have the fewest appendages of any crustacean, only seven in all. The branchiæ are attached to the mouth appendages. The antennæ are both tactile and swimming organs. There are two locomotive appendages and a well-developed bifid process to the tail. The body is inclosed in a horny bivalve shell. The eye is single.

The Copepoda have a carapace on the anterior part of body, the tail being left free. The antennæ are used for swimming. There are five swimming legs, the last being rudimentary. The tail has a bifid appendage. There are no branchiæ. There is usually a single eye situated near the front of the head. The Copepoda are found both in salt and fresh water. One of the best known is the CYCLOPS. Cetochilus becomes food for whales. Notodelphys is a harmless parasite in the respiratory sac of Ascidians. The Copepoda also include some external parasites (noticed under the heading EPIZOA), which are very curiously modified by their parasitic habits; the females have undergone most degeneration.

Xiphura contains one recent genus, Limulus (the king-crab), which existed in the Oolitic period, and two fossil genera referring back to the Upper Silurian period and becoming extinct in the carboniferous. The king-crab presents many points of agreement with the scorpion, and its arachnid character has been insisted on by Van Beneden and Ray Lankester. Its embryonic history is unlike that of any crustacean. The order Eurypterida, which is confined to the Palæozoic strata, is closely associated with Limulus.

The order Trilobita is exclusively fossil, belonging to the Palæozoic period. Its position is very uncertain. It is considered by some that the Trilobites represent a stage in the development of the king-crab. By others they are placed among the Edriophthalma near the ISOPODA, while others find their next-of-kin in Apus. See PHYLLOPODA, KING-CRAB, TRILOBITES.

ENTOZO'A (Gr. *entos*, within; *zoon*, animal) is a name applied to animals parasitic within the interior of other animals. The Entozoa do not form a natural group. See PARASITES.

EN'TRE-DOU'RO-E-MIN'HO, a province of Portugal, bounded N. by the Minho, which separates it from Galicia in Spain, S. by the Douro, which divides it from the province of Beira, W. by the Atlantic, and E. by the province of Tras-os-Montes. Its length is about 80 miles from N. to S., and its breadth is about 40 miles. Its area is about 3094 square miles, and its population in 1878 was 982,785. The surface of the province is hilly, but there are some plains near the sea-coast. One ridge of mountains, the Serra de Marao, runs from north to south through the east part of the province; the rivers Cavado, Ave, and Neiva, which flow south-west into the Atlantic, have their sources in these mountains. The river Lima, which, next to the Douro and the Minho, is the largest in the country, has its source in the mountains of Galicia; it flows south-west across the province, passes Ponte de Lima, and enters the sea near Viana. The river Tamega, which has its source in Tras-os-Montes, flows through this province in a southern direction, passes by Amarante and Canavezes, and then enters the Douro.

The province is the most fertile in Portugal, the climate is healthy, and the soil is irrigated by numerous streams. The principal productions are wine, oil, flax, Indian corn, wheat, oats, vegetables, and fruits of all sorts. Pastures are rather scarce, yet a considerable quantity of cattle, both large and small, are reared. The principal article of exportation is wine, which is made chiefly from the vineyards in the valley of the Douro, and is shipped at Oporto under the name of port wine. There are fisheries along the coast, which occupy a great number of hands. Its southern part has been comprised in the new province of Porto, and it is now divided into the comarcas of Braga and Viana, its chief towns.

E'OCENE is the name given to a series of rocks forming the base of the Tertiary or Cainozoic period. In England it lies unconformably on the chalk, and occupies two large basins in it, called the London and Hampshire basins respectively. In the London basin we find, as the lowest member of the series, beds of sand called the Thanet beds, at the base of which a layer of flints is found, derived from the underlying chalk. Above the Thanet beds come the Woolwich and Reading beds—clay, loam, and pebbles—with occasionally bands of sand; above these the Oldhaven beds, about 20 to 30 feet of pebbles and gravel. Overlying the Oldhaven beds we find the London clay, a richly fossiliferous stratum, attaining a thickness of 500 feet in the south of Essex. Above the London clay come the Bagshot sands, divided into lower, middle, and upper. In Hampshire a series of strata corresponding to the Woolwich and Reading beds, overlaid by the Bognor beds (the equivalent of the London clay), form the lower part of the series; above these come the Bracklesham beds and the "leaf beds" of Bournemouth and Alum Bay; while the Barton clay constitutes the uppermost member. The Isle of Wight affords numerous excellent exposures of Eocene rocks, and is a productive district for fossil hunters. The Eocene series is well developed in the Paris basin, the beds in this district being very rich in organic remains. Eocene rocks also cover a large area in Belgium. Great masses of Eocene limestone have been traced from the Pyrenees through the Alps, branching into the Apennines, the Carpathians, branches going into the Greek mountains, thence to the Balkans and to the mountains of Persia and Hindustan, and from the latter to the Chinese coast. This limestone, called Nummulitic, from its being in great part built up of the shells of Foraminifera belonging to the genus Nummulites, in places attains a thickness of several thousand feet; it is hard and compact, sometimes crystalline, and often much fractured and crumpled. In the Alps and Himalayas it has been raised up so enormously as to form high mountains. Thick beds of sandstones are associated with these limestones; the Flysch or Vienna sandstone, an enormous mass of sandstone stretching from Switzerland to the Danube, probably belongs to this epoch. Beds of limestone and sandstone of Eocene age, often of great thickness, are found in Scinde, Punjab, Assam, and Burma. The Tertiary rocks of North America are of enormous thickness, and have yielded abundance of organic remains. No exact parallelism between them and the European beds has been established, but the Eocene of the Old World is roughly equivalent to the Alabama series of North America.

The word Eocene is derived from the Greek words *eos*, dawn, and *kainos*, recent; the name being given to this epoch, because in it we find for the first time a fauna and flora corresponding to those now existing in the relative prominence and development of the great groups of animals or plants. Three and a half per cent. of the species of

Eocene shells are still existing, while all the cretaceous mollusca, with the doubtful exception of *Terebratula caput-serpentis*, belong to extinct species. In passing from the Cretaceous to the Eocene rocks, that is, from the Secondary to the Tertiary period, we come to a completely new order of things. The predominance of lycopods, cycads, and conifers is at an end, and the age of angiosperms (containing our deciduous forest trees and evergreens) commences. Many important genera of mollusca, notably among the cephalopods, disappear, but the most remarkable change is the decrease in the number of forms and size of individuals among the reptiles, accompanied by an enormous increase of mammalian forms; the mammals, which formed an insignificant group in the Secondary period, now taking the lead among vertebrata which the reptiles held during Secondary (or Mesozoic) times. But it must be borne in mind that though this enormous gap is found in the English formations it by no means follows that there was a break in the continuity of the life-history of the world. At Maestricht, near Paris, and at Faxoe (in Zealand) beds have been found containing cretaceous forms of life mingled with Eocene types, thus bridging over the hiatus observable in our own formations, and pointing conclusively to a gradual passage from Secondary to Tertiary conditions —as *we* understand these terms; for geology emphatically teaches us that such terms as Palæozoic, Mesozoic, and Cainozoic are terms which must be used not absolutely, but for convenience: they indicate no abruptly terminating or definitely commencing periodsi n the history of life.

Both the fauna and flora of the Eocene epoch indicate a subtropical or tropical climate. The Lower Eocene flora is remarkably Australian in character, many forms being closely allied to existing Australian ones. Towards the end of this period, however, the flora assumes a distinctly American aspect. Palms and proteaceous plants are abundant—magnolia, melon, custard-apple, oak, eucalyptus, laurel, cypress, elm, beech, willow, &c., are found, also Pandanus and cactus. The distinguishing points about the fauna have been mentioned. The foraminifer Nummulites (so named from the resemblance of its flat discoidal shell to a coin) is important from its forming rock-masses of great extent. Among the mollusca the genera Belosepia, Nautilus, Cypræa, Natica, Cyrena, Cytheræa, Cerithium, Melania, and Turitella are well represented. Fish remains are mainly teeth and spines; the chief genera determined are Lamna, Phyllodus, and Otodus. Bird remains are tolerably abundant, the most interesting being *Dasornis londinensis*, a form allied to the extinct Dinornis of New Zealand, and *Odontopteryx toliapicus*, a toothed bird of pterosaurian aspect. The Mammalia are mostly synthetic types [see SYNTHETIC]; the most noteworthy are—Arctocyon, an animal combining many marsupial and ursine peculiarities; Palæonictis, a marsupial; Pterodon and Provivera, the progeners of the Carnivora; Hyracotherium, a pig-like form, but with tapiroid affinities; Cœnopithecus, the earliest monkey (a lemur). An abundant group of tapirs occurs, including the genera Coryphodon, Palæotherium, and Lophiodon. While Anchitherium, the ancestor of the horses, was intermediate between the tapirs and the horse proper, Cynodon and Amphicyon connected the marsupials with the wolves and foxes respectively. There were also representatives of our existing squirrels, bats, deers, and hedgehogs, besides numerous opossums. The American beds have yielded Eohippus, a horse-like form, with a rudimentary fifth toe; Eothyus and Parahyus, ancestral forms of the hog; and a very extraordinary group of animals, Deinocerata, rhinoceros-like forms as large as elephants, with a pair of horns on the snout, a pair on the forehead, and one on each cheek.

The mineral wealth of the Eocene rocks is not great. Coal is found at Häring in Tyrol, and lignite in India. Gypsum is found abundantly in the London clay and in the Paris basin; it was extensively worked at Montmartre, near Paris, and burned to form "plaster of Paris;" but the most important gypsum bed of this series is now included among the Oligocene strata.

EORL was a title of the ancient English nobility, and must on no account be confounded with the Danish *jarl*, afterwards called *earl*. The early English monarchs had also a nobility of service, like the *jarls*, but these were *thegns*; the English eorl was a noble by blood, and the king could not create the dignity. An eorl's WERGILD was 1200 shillings, and his oath outweighed that of six CEORLS. By Athelstan's time the aristocracy of birth had become of slight account, and wealthy ceorls who were thegns were the practical superiors of eorls who were not; both eorls and ceorls became thegns therefore, and the poorer ceorls sank into a dependent state attached to some of the lords of the land, and not far removed from serfage.

E'OS, Goddess of Dawn. See AURORA.

EPACRID'EÆ, an order of GAMOPETALÆ, very closely allied to the Heaths (Ericaceæ), with the small-leaved genera of which they entirely agree in habit, and from which they are scarcely distinguishable. The chief point of difference lies in the anthers, which are one-celled, discharge the pollen through a longitudinal chink, and have no appendages. There are two other differences which are important—the stamens generally adhere to the sides of the corolla, and the leaves have parallel veins like those of monocotyledonous plants.

The species consist of shrubs with alternate or occasionally opposite leaves. The size and colour of the corolla are often striking, and the species then become exceedingly showy, and are favourites with gardeners.

There are twenty-six genera in this order, divided into 320 species, which are natives chiefly of extra-tropical Australia; they are also common in New Zealand and New Caledonia, but are rare in the Malay Archipelago, the Fiji and Sandwich Islands; one species is found in Terra del Fuego. In those countries where they are common they completely take the place of the Ericaceæ.

The fruit is either capsular or drupaceous, the drupe being dry or pulpy. The pulpy drupes are edible. The Tasmanian Cranberry is the fruit of *Astroloma humifusum*, a trailing plant, somewhat like juniper, with scarlet blossoms in winter. The native currant of Australia is the fruit of *Leucopogon Richei*. Other edible fruits are those of *Lissanthe sapida* and *Styphelia ascendens*.

E'PACT is a term in chronology expressing the difference between the moon's month and the sun's month, or between the lunar year of twelve months and the solar year. The solar year is 365 days, and twelve lunar months occupy 354 days, excluding fractions in each case. The yearly epact is therefore eleven days, and calculations (such as that of Easter) involving lunar adjustments must be rectified by eleven days. The new moon occurring on 1st January in any year, for instance, it would occur at the end of the first year afterwards eleven days before 1st January; and so also the epact for the second year is twenty-two; but the epact for the third year is three instead of thirty-three. because we have now accumulated an error of an entire lunation of thirty days, and thirty is therefore deducted. The epact of the fourth year is $(3 + 11)$ fourteen; that of the fifth year twenty-five; but that of the sixth year $(36 - 30)$ six, and so on. It will be found that the nineteenth year will have thirty for its epact, that is of course $(30 - 30)$ zero; and the cycle begins again. The nineteen years of each cycle are numbered with a "golden number," I., II., III., &c.

At the time of the rectification of the Julian calendar eleven days had to be omitted—exactly a yearly epact—, consequently the Gregorian epact is one year ahead of the old-fashioned or Julian epact; that is to say, the Julian epact of 1890 is the same as the Gregorian epact of 1891.

The word comes from the Greek *epaktos*, imported, thrust in. See also CALENDAR.

EPAMINON'DAS, one of the greatest men of ancient Greece, a Theban statesman and soldier, in whose praise, both for talents and virtue, there is a remarkable concurrence of ancient writers. Before Epaminondas was born, and after his death, Thebes was always in subjection to some other power; while he directed her councils she was, on the contrary, the head of Greece. His public life extends from the restoration of democracy, by Pelopidas and the other exiles, 379 B.C., to the battle of Mantineia, 362 B.C. In the conspiracy by which the revolution of 379 B.C. was effected he took no part, but thenceforward he became the prime mover of the Theban state. His policy was first directed to maintain the power of Thebes over the other cities of Bœotia, and in this cause he ventured to engage his country single-handed in war with the Spartans, who marched into Bœotia, 371 B.C., with a force superior to any which could be brought against them. Epaminondas notwithstanding inflicted upon them the memorable defeat at Leuctra, involving the overthrow of the supremacy of Sparta, and the substitution of Thebes as the leader of Greece. A Theban army under his command, with Greek allies, marched into Peloponnésus early in the winter, 369 B.C. Numbers of the Helots took that opportunity to shake off a most oppressive slavery; and Epaminondas established these descendants of the old Messenians on Mount Ithome, in Messenia, as an independent state. In 366 B.C. he went as an ambassador to Achaia, and by his moderation and judgment succeeded in bringing that whole confederation over to the Theban alliance.

A great part of the Peloponnesus soon returned to the Spartan alliance, and to check this defection Epaminondas led an army into Peloponnesus for the fourth time, 362 B.C., and endeavoured to take Sparta by surprise; but the vigilance of Agesilaus frustrated this scheme. Epaminondas then marched against Mantineia, near which was fought the celebrated battle in which he received a mortal wound, just at the time when the Lacedæmonian line was broken. He was told that his death must follow at once on the extraction of the javelin from his body; he bore the agony just so long as was necessary to learn the complete victory of his beloved country, and to have his shield brought to him safely (since to lose his shield was with the Greek soldier as great a loss of honour as the surrender of the regimental colours with our modern warriors), and so soon as his mind was at rest for his country's honour and his own, he himself drew out the weapon and died. The battle of Mantineia had no result, save the sudden downfall of the supremacy of Thebes.

EPAULEMENT, a mass of earth, about 7 feet 6 inches high and 18 or 20 feet thick, raised for the purpose either of protecting a body of troops at one extremity of their line, or of forming a wing or shoulder of a battery. The term is also used to designate the whole mass of earth or other material which protects the guns in a battery both in front and on either flank. That part of the epaulement which is between every two embrasures is called a merlon, and the part under the embrasure is called the genouillère.

EP'AULETTE, an ornamental badge or mark of distinction worn on the shoulder by naval officers. It originated under Louis XIV., from the ribbon which held the sword-belt in place on the shoulder. In the British navy lieutenants and their superior officers wear two epaulettes of gold lace, one on each shoulder, the sub-lieutenants wearing only one. Before the Crimean War they were worn in the army both by officers and men, but were abolished in consequence of the danger to which the officers were exposed by the superior make of their epaulettes rendering them distinctive objects to the enemy.

EPÉE, CHARLES MICHEL DE L', was born at Versailles in November, 1712. He was educated for the church, ordained, and received a canonry in the cathedral of Troyes. An accidental circumstance led him to devote himself to the instruction of the deaf and dumb, and he persevered until he converted opposition and contempt into approbation. His income was about £400, of which he allowed about £100 for his own expenses, and appropriated the remainder to the support and instruction of indigent mutes. M. de l'Epée died 23rd December, 1789, aged seventy-seven. He ranks deservedly among those whose lives have been devoted to the amelioration of the condition of their fellow-men, and the fruit of whose labours do not die with them. See DEAF AND DUMB.

EPEI'RA is the generic type of the Epeïridæ, a family of SPIDERS (Araneidea). In this genus the abdomen is generally large, rounded or oval. The legs are long, the third pair being the shortest; the tarsi are terminated by three or more claws. The first pair of appendages, the falces, are conical, and their bases are furnished with one row of teeth. The maxillæ are short and strong. The eyes are placed in three groups, the four middle eyes forming a square figure, having on each side a pair placed on a tubercle. The well-known nets, formed by warping concentric threads on straight radii, which may be seen in almost every garden, are the work of one species of this family—the Garden Spider (*Epeïra diadema*). In tropical climates many large forms occur, whose nets are much stronger than those of the British species. The spiral threads of the elastic net constructed by species of this genus are different in structure not only to those of the rest of the web, but also to those spun by any other family of spiders. They consist of slender elastic, sticky threads, covered at irregular intervals with little beads of viscid matter, which does not harden on exposure to the air. In the very centre of the web the threads are not sticky, and here it is that the spider lies in wait for his prey. The web needs to be daily repaired and renewed. Near the web a nest or cell is constructed, varying in form in different species, from which a strong line runs to the centre of the web. No sooner does an insect touch any part of the net, or of the silken cords that retain it in its position, than the spider, through the delicacy of its sense of touch, becomes instantly aware of its presence. The Garden Spider may always be tempted out of its hiding-place by touching its web lightly. The female Garden Spider is nearly half an inch long. The male, as usual in this order, is much smaller than his partner, and is not unfrequently killed and eaten by her. The female is beautifully marked.

Garden Spider (*Epeïra diadema*)—female.

EPEN'THESIS, the insertion of letters in words during their passage from one language to another. Thus from the French *caporal* comes our corporal, from the

Italian *velluto* our velvet, from the Latin *locus* comes the Italian *loggia* and our lodge, from the old English *knowleche* comes our knowledge, &c. (The *lech* in this last is a Scandinavian suffix, adopted from the Danes in later times before the Norman conquest.)

EPERNAY, a town of France, in the department of Marne, stands in a rich vine district near the left bank of the river Marne. It is the central point of the champagne trade. The spacious cellars hewn in the chalk are admirably suited for storing the wine, and contain millions of bottles. M. Moet's cellars are sunk 40 feet below the street. The town is well built and clean. It has 15,876 inhabitants, who, in addition to the trade in wine, manufacture hosiery, pottery, sugar, and leather. Epernay was taken by Henry IV. in 1592, after an obstinate siege, in which Marshal Biron was killed.

E'PHAH or **EAPHA**, among the Hebrews, a measure of capacity which held 60 lbs. avoirdupois of water; but the ephah of the sanctuary was one-third larger.

EPHED'RA, a genus of plants belonging to the order GNETACEÆ. The species are not numerous (about thirty), and are found in Europe, Asia, Africa, and America. *Ephedra vulgaris* is a native of France and some parts of Germany, and abounds in the southern parts of Europe, and thence eastwards to Persia and India. The berries, which consist of the fleshy calyx covering the ovary, ripen in July and August. They have a sweetish taste, and contain a mucilaginous juice. In Hungary and Siberia they are eaten as a great luxury. The plants are leafless shrubs with jointed branches, and scales opposite the nodes joined into a sheath. The flowers are either male or female, and occur singly within bracts which are decussately opposite; the male flowers are in all the axils of the spicules, but there are only one or two female flowers at the top of the spicule.

EPHEM'ERA. See MAY-FLY.

EPHEM'ERIS (Gr. *epi*, and *hêmera*, a day), a name given to almanacks, from their containing matter for each day. In astronomy it is usual to call any table which assigns the place of a planet for a number of successive days an ephemeris of the planet.

EPHE'SIANS, ST. PAUL'S EPISTLE TO THE, was most probably written during the apostle's first captivity at Rome (61–63 A.D.), at a period when his imprisonment had not assumed the severe character which marked its close. Its genuineness and authenticity were universally admitted until a very recent period, and though they have been assailed somewhat vigorously by several eminent German critics, there seems to be little ground for calling in question the verdict of antiquity. It is cited as the work of the apostle by Ignatius, Irenæus, Clemens Alexandrinus, Tertullian, Origen, and many subsequent Christian writers, while the internal evidence points unmistakably in the same direction. One point in connection with the epistle, viz. its direction, is still much disputed, and it is noteworthy that the controversy is but a reproduction of one that arose about the middle of the second century. In the Sinaitic and Vatican MSS., and in a valuable Cursive MS. of the twelfth century, the words "at Ephesus," in the first verse of the Authorized Version, are wanting; and that this was also the case with many of the copies in use at the earliest periods is evident from the patristic writings. Hence it has been suggested that the epistle was a circular letter addressed to several churches, that at Ephesus being among them, while also weighty arguments have been found in favour of the opinion that it was addressed rather to the Gentile converts in Asia generally, and that it is in reality the supposed lost Epistle to the Ephesians.

The epistle is divided into two parts, the first doctrinal, dealing with the purpose of God to gather up all nations in one in Christ Jesus, and of the glory of Christ and his church on earth; and the second, after the manner of the apostle, of an hortatory and practical character. It resembles in many respects the Epistle to the Colossians, and is generally regarded as being written at about the same time as that epistle, but it has also important differences, and it may be fairly said that the two letters are complementary to one another.

EPH'ESUS, a city of Asia Minor, and one of the twelve that belonged to the Ionian confederation (Herod. i. 142). The ruins of the city are situated near the river Caÿster, at a short distance from the place where it falls into the Bay of Ephesus, and near a modern village called Ayasalouk.

The epoch of its foundation is very remote, being ascribed by some to the Amazons; but it subsequently received a colony of Ionian Greeks under Androclus, the son of Codrus, and thenceforth occupied a distinguished place among the twelve confederated Ionian cities of Asia Minor. From the remotest period Ephesus was celebrated for a temple of Diana, hence called the Ephesian goddess, in its immediate vicinity; and on being besieged by Crœsus, the inhabitants made an offering of their city to Diana, uniting it to her temple by a rope 7 stadia (seven-eighths of a mile) in length. (Herod., i. 26.) Subsequently to this period the original city was gradually abandoned, and a new one grew up round the temple. The wealth they accumulated by their great commerce enabled the Ionian cities to erect, at their joint expense (*factum a totâ Asiâ*, Plin., xxxvi. 21), a noble temple at Ephesus in honour of Diana, in which was placed her image on ivory, said to have been sent down from heaven by Jupiter. This sacred edifice, accounted one of the finest structures of its time, escaped that destruction in which all the Greek temples of Asia Minor were involved through the impotent fury of Xerxes after his expulsion from Greece. But it soon after fell a sacrifice to the insane rage for notoriety of an obscure individual of the name of Herostratus, who, to perpetuate his memory, set fire to the temple. Alexander the Great offered to rebuild the temple, provided he were allowed to inscribe his name on the front; but this was declined by the Ephesians, who, principally at their own cost, but partly also by the voluntary contributions of others, raised a new temple to the goddess far transcending its predecessor, and such as entitled it to be ranked among the seven wonders of the world. To lessen the risk of injury from earthquakes, it was built on the margin of a marsh, its foundations costing an immense expense. It was 425 feet in length, 220 feet in breadth, and adorned by 127 columns of the Ionic order, each 60 feet in height (Plin. "Hist. Nat.," xxxvi. 14). The altar was the work of Praxiteles; the famous sculptor Scopas also contributed to the embellishment of the fane, which, among other chefs-d'œuvre of art, could boast of a noble picture of Alexander the Great by Apelles, a native of the city. An extensive sanctuary was attached to the temple, but this privilege was annulled by Tiberius on account of the abuses to which it led.

The site of the celebrated temple, after several years of unremitting labour, was clearly determined in 1876 by Mr. J. T. Wood, whose work on the subject is a standard authority. ("Discoveries at Ephesus," London, 1877.) In Strabo's time Ephesus was a place of great trade, and the chief commercial city of the western part of Asia Minor: and as appears from the Acts of the Apostles (xix.) it was of note for workers in silver. In the present day the site of the once proud city is simply a mass of debris.

EPH'OD, a kind of girdle or short cloak worn by the Jewish priests, which passed from behind the neck over the two shoulders, and thus hung across the stomach. There were two sorts, one for the common priests, made of plain linen, and another embroidered, for the high priest, composed of gold and blue or crimson twisted cotton. On that portion which came across the shoulders were two

precious stones, with the names of six tribes engraven on them; but where the ephod crossed the breast there was a square ornament, set with precious stones, on each of which the name of one tribe was engraven.

EPH'ORS (Gr. *ephori*, *i.e.* overseers), a body of magistrates at Sparta, five in number, who possessed great powers. The institution of this office is lost in antiquity, but is sometimes ascribed to Theopompus, the grandson of Charilaus the Proclid. Every Spartan was eligible to the office. The ephors were chosen in the autumn of every year. The first gave his name to the year. They were empowered to fine whom they pleased, and exact immediate payment of the fine; they could suspend the functions of any other magistrate, and arrest and bring to trial even the kings. They presided and put the vote in the public assemblies, and received and dismissed embassies, treated with foreign states, and sent out military expeditions. The king who commanded was always attended by two of the ephors, who exercised a controlling power over his movements. In fact from being at first the deputies of the king when absent they became *de facto* rulers of the state, and the two kings (Sparta had two, and not one, on the throne at a time) were for a long time reduced almost to the position of hereditary generals of the army, or little better. Aristotle so speaks of them. The ephors were murdered on their seats of justice by Cleomenes III. B.C. 225, and their office overthrown; but they were restored by Antigonus Doson and the Achæans in 222 B.C. (Polyb. ii. 70). The office existed under the Roman dominion.

EP'IC POETRY is that form of art which produces an imaginative description of external facts and occurrences, as distinguished from lyric poetry, which employs itself in registering, in an imaginative manner, all those internal facts and occurrences which go by the name of feelings and emotions.

Men can invent before they can analyse, and epic poetry thus precedes lyric; further epic poetry precedes history, and the reason is that facts, real or supposed, take the imaginative form of poetry before they are recorded and examined with regard to the conclusions which they suggest. The heroic age of Greece, for instance, as far as we know anything about it, was very little likely to encourage reflection, much less reflective poetry or coldly recorded history, and accordingly we hear nothing of such works until centuries after it had ceased.

The earliest specimens of this form of art probably consisted of tales rhythmically arranged and recited to a very simple musical accompaniment. The poet, setting before him no aim, or seeing it but imperfectly, acted purely from the stirring impulse of his own imagination. Into this class we may perhaps admit some of our oldest and simplest English and Gothic romances, but the poetry of Homer and Hesiod, the twofold epic of the Greeks, cannot be denied to be, in great measure at least, the work of conscious artists.

The attention of early Greece was centred on two grand ideas, the state and religion, whence we find a political and a hieratic epos. The Iliad and the Odyssey of Homer (possibly about 950 B.C.) are the two poems which remain as specimens of the former kind, and they are particularly worth the attention of all who are interested in the history of epic poetry, as they afford by far the most perfect instance of poems of that kind composed in an age differing but little in its characteristics from that to which they refer, and stand consequently in strong contrast to the Æneid, a poem with which they are most frequently compared. The Æneid of Virgil, written in the last century before our era, depends more on beauty of language and arrangement than on anything in the story; the interest in Æneas is very inferior to the interest in Ulysses as created by the Odyssey.

Sacred poetry partakes strongly of a lyrical character, and Hesiod ("Works and Days") has perhaps struck out the only path which an epic writer in a simple age could follow without lapsing into the lyrical spirit as he approached theological subjects.

It has been observed by Schelling that an epic poem has no regular beginning or end; it is a metrical and imaginative production, which, if it consist of narrative, may take it up and lay it down at any period. This is the case with the Iliad, as well as with the Odyssey and the Æneid, although the last two are considerably more complex in the arrangement of the narrative, and evidently draw to a more decided close than the Iliad.

The northern nations possessed numerous poems of an epical kind, some of which remain and may be read with interest. The cycles of romances on Troy and Alexander the Great compose a form of art which could only exist in a revival of imaginative spirit, as they derive their subjects from an older date and a different country, although, as regards everything but the name of Greek or Trojan, the hero is usually the countryman of the bard; but the numerous poems on Arthur, with "Havelok the Dane," "King Horn," and "Beowulf," in the early forms of our own tongue, the poem of "The Cid," in Spanish, and the "Nibelungenlied," in old German, are sufficient proofs of the coincidence of epic spirit with an early stage of society. The Italian epic arose somewhat later than that of any of the northern nations, which may be attributed to the fact that it was only to a strong admixture of barbarian blood that the Italians owed their restoration to political existence.

Perhaps the greatest difference which is traceable between the ancient and the modern epic has been produced by that spirit of devotion to the female sex which characterizes all the Gothic nations; which, arising as it does partly from the refinement of an instinct and partly from religious impressions, is superior, as a motive of action, to the mere unmitigated passion for war which constitutes the prevailing features of the ancient epic, or at least of the heroic poems. Epics of modern times fail for the reasons set forth above. They are artificial productions, like the Æneid, which would probably be better in a more natural form. The best example is Tennyson's Arthurian epic, divided into separate books with the collective title of "Idyls of the King"—a masterpiece of imagination and pure fancy, but artificial to the extreme of unreality, probably as unlike the historical Arthur and his age as anything that could be devised. Its beauty as language alone saves it from failure through its falseness. In all probability some of the simple songs of the laureate will outweigh all the many pages wasted on the hopeless task of an epic.

EPICTE'TUS was born at Hierapolis, in Phrygia, probably some time in the reign of Nero. In some way he became a slave at Rome to Epaphroditus, who was a freedman of Nero's and one of his bodyguard. We are not told how or when Epictetus managed to effect his freedom; but he could not have been still a slave when he left Rome in consequence of the edict against philosophers, A.D. 89, in the eighth year of Domitian. Epictetus retired to Nicopolis, in Epirus, and it is a question whether he ever returned to Rome. The chief ground for believing that he did is a statement of Spartian that Epictetus lived on terms of intimacy with the Emperor Hadrian. We do not know when he died. Aulus Gellius, writing during the reign of the first Antonine, speaks of Epictetus in two places as being dead.

Epictetus led a life of exemplary simplicity and virtue. He lived for a long while in a small hut, with no other furniture than a bed and lamp, and without an attendant, until he benevolently adopted a child whom a friend had been compelled by poverty to expose, and hired a nurse for its sake. The biographers of Epictetus have also commemorated his love of order amidst simplicity, a strong distinction between the high-minded Stoics and the brutal

Cynics. Epictetus was a teacher of the Stoic philosophy, and the chief of those who lived during the period of the Roman Empire. The lessons of Epictetus were directed to practical morality. His favourite maxim was "Bear and forbear." He was himself patient to a fault. While a slave, and undergoing a severe beating, he gently remarked to his master that he was over-violent and might injure him, which would be foolish, as it would damage his property. A few moments after, by greater violence still, his master broke the leg of Epictetus. "Now you see," said he, "I am lame for life, as I feared would come about." Conquered by such virtue his master set him at liberty. The story is so well known that it is here set down, but it is only proper to say that it is not well authenticated. But like many other original men and founders of sects, Epictetus appears to have written nothing. His "Discourses" were taken down by his pupil Arrian, and published after his death in six books, of which four remain. Arrian also compiled the "Encheiridion," and wrote a life of Epictetus, which has been lost.

The best edition of all the remains of Epictetus is that by Schweighäuser (in six vols., Leipzig, 1799). The same editor has published the "Encheiridion," together with the Tablet of Cebes, in a separate volume. There is an excellent translation by George Long (London, 1877).

EPICU'RUS was born in the year 341 B.C., in the island of Samos, seven years after the death of Plato. He went to Athens at the age of eighteen. At this time Xenocrates was teaching in the Academy and Theophrastus in the Lyceum, and it is said that Epicurus was a pupil of Xenocrates. But Epicurus used to boast that he had learned from no man but himself.

Epicurus did not stay long at Athens, and he went to Colophon to join his father. In his thirty-second year, 310 B.C., he went to Mitylene, where he founded a school. Staying only one year at Mitylene, he next went to Lampsacus, where he taught for four years. He returned to Athens in the year 306 B.C., and founded a school which ever after was named after him. He purchased a garden wherein he might live with his disciples and deliver his lessons, and henceforth remained in Athens, with the exception only of two or three visits to his friends in Asia Minor, until his death in the year 270 B.C. He was in his seventy-second year when he died.

Epicurus had numerous pupils. He lived with them in his garden in a state of friendship; they did not put all their properties together, but enjoyed them in common. The friendship subsisting between Epicurus and his pupils is commemorated by Cicero. They lived in a frugal and virtuous manner, though their enemies took pains to represent their life in a different light. At the entrance of the famous garden was this inscription:—"The hospitable owner of this place, where you will find pleasure regarded as the highest good, will present you liberally with barley-cakes and water fresh from the spring. The gardens will not provoke your appetite by artificial dainties, but satisfy it with natural supplies—will you not be well entertained?" Epicurus did not marry, in order that he might be able to prosecute philosophy with less interruption. His most attached friends and pupils were Hermachus of Mitylene, whom he appointed by will to succeed him in the school; Metrodorus, who wrote several books in defence of his system, and for whose children Epicurus, in his will liberally provided; and Polyænus. On his death Epicurus left his garden and a house that he had near Athens to Hermachus, as head of the school, to be left by him again to whomsoever might be his successor. Though not a book of Epicurus remains, yet such abundant quotations and fragments are existent that we are able almost to reconstruct his work. He was among the most voluminous of Greek writers.

Epicurus divided the whole field of knowledge into three parts, to which he gave the names respectively of *canonics*, *physics*, and *ethics*. The first two were subordinate to the third. The end of all knowledge, of ethics directly or immediately, of canonics and physics indirectly or mediately through ethics, was, according to Epicurus, to increase the happiness of man. Philosophy, he said, was the art of life and not the art of truth.

Canonics, which was a subject altogether introductory both to physics and ethics, treated of the means by which knowledge, both physical and ethical, was obtained, and of the *criteria* of truth. These criteria were, according to him, sensations, ideas or imaginations, and emotions. From these three sorts of consciousness we get all our knowledge. What Epicurus then called canonics is about equal to what we call psychology. In physics he trod pretty closely in the footsteps of Democritus.

In his ethics Epicurus taught that a man ought to increase his pleasures and diminish his pains as much as possible. He used the terms pleasure and pain in the most comprehensive way, as including pleasure and pain both of mind and body; and he esteemed the pleasures and pains of the mind as incomparably greater than those of the body. Making, then, good and evil, or virtue and vice, depend on a tendency to increase pleasure and diminish pain or the opposite, he arrived at the several virtues to be inculcated and vices to be denounced. Temperance, as permitting length of pleasure and freedom from pain, he regarded as a great virtue. Possessions he despised as much as the Stoics. Wealth, he taught, depends not on having much, but on wanting little. It was not difficult for him to show that no life was truly a life of pleasure except a virtuous life.

Though Epicurus dispensed with a demiurgus, or creator of the world, he yet did not deny the existence of gods. These gods were eternal and supremely happy, living in a state of quiet, and meddling not with the affairs of the world. He contended that they were to be worshipped on account of the excellence of their nature, not because they could do men either good or harm. The two chief sources of knowledge concerning the doctrines of Epicurus are the tenth book of Diogenes Laertius, and the magnificent Epicurean poem of Lucretius, "De Rerum Natura."

EP'ICYCLE, a circle the centre of which is carried round upon another circle: a term of the Ptolemaic hypothesis. By the unlimited use of epicycles the movement of the sun and planets round the earth was long explained; but long successions of observations made the series of epicycles upon epicycles become so absurdly complicated that men searched for a simpler hypothesis. See COPERNICUS, KEPLER.

EPICY'CLOID, a curve dependent on the CYCLOID. It has been shown that a cycloid is formed by a point on the circumference of a circle rolling along a straight line. An epicycloid is produced when the circle rolls along the exterior of the circumference of another circle—if it roll along the interior of the circumference the resulting curve is called a hypocycloid. Epicycloids are useful for many practical purposes, and are indeed necessary for the accurate construction of interlocking wheel-work, as cogwheels and spindles, &c.

EPIDAU'RUS, distinguished as *Hiera* (the holy), a city of ancient Greece, situated on the eastern coast of Argolis, on a small bay in the Saronic Gulf, and surrounded by mountains on the land side. When the Dorians got possession of Argos, Epidaurus admitted a Dorian colony. The constitution of Epidaurus was originally monarchical. In the time of Periander of Corinth his father-in-law, Procles, was tyrant of Epidaurus (Herod. iii. 58). Afterwards the government was aristocratical. Epidaurus was the mother-city of Ægina and Cos, the former of which was once dependent upon it. As the chief seat of the worship of Æsculapius, Epidaurus was for a long period a highly

important place. The modern village, Epidavro, has about 100 inhabitants, and was the meeting-place of a congress from all parts of Greece in 1822, which promulgated the constitution of Epidaurus. There were two other cities of this name; one in Laconia, called Epidaurus Limera, which had also a well-known temple of Æsculapius. The third Epidaurus was a maritime city of Illyricum.

EPIDEM'IC diseases are those which prevail among a large portion of the people of a country, rage for a certain time, and then gradually diminish and disappear, returning often at periods more or less remote. The cholera, influenza, various forms of fever, diphtheria, measles, &c., frequently assume this character. The infectious character of such diseases is due to the diffusion of those germs by which the disease is caused.

EPIDEN'DRUM is the name of a genus of plants belonging to the ORCHIDEÆ. There are as many as 400 species, natives of tropical America, a few occurring even in the northern states of North America. Some are very beautiful, and even the least inviting are interesting from their singular formation. Most grow on trees, and hence the generic name (from the Greek *epi*, upon; and *dendron*, a tree). The stem is long and leafy in some species, and in others is reduced to a pseudo-bulb. The leaves are leathery and generally strap-shaped; and the flowers are terminal, occurring either solitary or in a raceme. The base of the lip is more or less united to the column, while the blade of the lip is spreading. There is one anther, with two distinct parallel cells; there are four pollen masses, collateral, compressed, in one series.

Epidendrum bicornutum is a very chaste and lovely plant, but there is difficulty in growing it, for it requires great heat, plenty of moisture, and good ventilation. *Epidendrum vitellinum* is a fine species, and remains a long time in bloom. It is best grown in pots in a cool house, with plenty of light in winter and liberal supplies of water in summer. The colour is a brilliant deep orange.

EPIDER'MIS or **CUTICLE**, that somewhat horny epithelium which covers the *dermis* or true skin, on the exterior of the body. See SKIN, EPITHELIUM.

EPIDERMIS, in botany, is the name given to the outer layer or layers of cells in the younger parts of plants. In mosses and other cellular plants there is scarcely any difference between the outer cells and those lying underneath. In vascular plants it consists originally of a single layer, but sometimes this splits up, by divisions parallel to the surface, into two or more layers. The cells of the outermost layer, the true epidermis, have much thickened walls and are smaller; they are wanting in chlorophyll and starch, except in ferns and some water-plants, and the sap is generally colourless. The epidermis can be detached from leaves with a little care, and forms an interesting object for the microscope, as the stomata or breathing-pores can easily be seen. The outermost part of the cell-walls in the epidermis is usually much thickened, no trace scarcely of cellulose is left, and this layer of the cell-walls runs on from cell to cell, forming the *cuticle*.

EP'IDOTE is a mineral crystallizing in the monoclinic system; it has a hardness of 6 to 7, and a specific gravity of 3·25 to 3·5. In colour it varies from yellowish-green or pistachio green to black; in composition it is a silicate of lime, alumina, and peroxide of iron. Epidote is found in schists and in crystalline rocks, such as gneiss, granite, and syenite. The epidote granite of India, a remarkably beautiful rock, contains it in great abundance. The chief localities for the mineral are—Arendal in Norway, Ala and Traversella in Piedmont, Bourg d'Oisans in France, Zitterthal in Tyrol, and Achmatovsk in the Urals. A beautiful variety—brilliant black by reflected, and greenish-brown by transmitted light—is found at Knappenwand in Tyrol. The terms *thallite*, *pistacite*, and *delphinite*, formerly synonyms of epidote, have quite gone out of use.

EPIGLOT'TIS (Gr., on the glottis), in anatomy, an elastic and flexible cartilage of the larynx, situated above the glottis. Its use is to prevent the passage of the food into the windpipe during the act of swallowing, at which time it closes over the larynx, and allows the food to pass over it into the œsophagus.

EPIG'ONI, THE, in classical mythology, were the descendants of the famous "Seven against Thebes." [See ANTIGONE.] Ten years after those seven princes perished their seven sons, the *epigoni* (descendants), marched in their turn against Thebes to avenge the fate of their fathers. Alcmæon and Diomed were among them, and the first was in command. The expedition was successful, and great part of Thebes was razed to the ground. The story was a favourite one with ancient writers, and is frequently alluded to by moderns in noting the revenges of time.

EP'IGRAM (Gr. *epigramma*), an inscription, whence it comes to signify a short poem, such as might be comprised within the limits of an inscription. For an account of the class of poems called epigrams by the Greeks, see ANTHOLOGY. Much of early Greek history was preserved in epigrams, to which Herodotus and Thucydides often refer; as, for instance, those concerning the battle of Thermopylæ (Herod. vii. 228), one of which is thus literally translated:—"Here once four thousand from Peloponnesus fought with three millions."

The Latin epigram approaches nearer to the English acceptation of the term. The most distinguished Latin epigrammatists are Catullus and Martial, in whom there is much wit with much scurrility and obscenity; but many of the epigrams of Martial are epigrams in the Greek sense, and some of them are characterized by great propriety of thought and felicity of expression. The "Latin Anthology" of Peter Burmann the Younger contains a large collection of epigrams by numerous authors, of which many resemble in simplicity the Greek epigrams.

In English the word signifies a short poem, which to be good in its kind must be clear, concise, and elegant in expression, and must contain a point, that is, some striking and unexpected turn of thought—whether it be humorous or serious is indifferent. The following compliment addressed by Pope to Lord Chesterfield, on being asked to write with that nobleman's pencil, may serve as well as any for a specimen:—

> "Accept a miracle; instead of wit,
> See two dull lines by Stanhope's pencil writ!"

Pope, Swift, Burns, Byron, Moore, and many other English writers, excelled in the use of epigram; while among modern orators, perhaps none have possessed the gift in so remarkable a degree as the late Lord Beaconsfield.

EP'ILEPSY (Lat. *epilepsis*, a seizing: synonyms, *Morbus divinus*, *herculeus*, *comitialis*, and *caducus;* also *Falling Sickness*) is a sudden abolition of sensation and consciousness, with CONVULSIONS of the muscles of voluntary motion, ending in a state of sopor or apparent sleep, the attack recurring in paroxysms more or less regular. The attack of epilepsy is usually quite sudden. The person, while in his ordinary health, and perhaps engaged in his usual occupation, utters a piercing scream. If standing he falls to the ground, where he lies for a moment in a state of extreme rigidity, almost amounting to tetanic stiffness; but this state is quickly succeeded by convulsions, which variously agitate the limbs and the trunk of the body. The head is generally thrown backwards; the eyes are open, fixed, and staring; the pupils are dilated; the vessels of the head and neck are swollen, rendering the countenance flushed, and sometimes of a dusky hue; the muscles of the face are in violent action, producing frightful distortions of the countenance; the muscles that move the lower jaw close the mouth with violence, producing gnashing of the teeth; the tongue, which

is swollen and livid, is thrust out forcibly between the teeth, and is often grievously wounded; the arms are sometimes tossed violently about the chest, or struck against it; the hands and fingers are in a state of rapid alternation, between the motions of flexion and extension; the lower extremities are agitated in a similar manner; the thumbs are drawn inwards, and the toes incurved; and a quantity of frothy saliva flows from the mouth, which is often bloody from the wounds inflicted on the tongue. The muscles on one side of the body are commonly more violently agitated than those of the other. The pulse, always difficult to be felt, is commonly quick and small; but it becomes distinct towards the end of the paroxysm, and is then more slow and languid. The action of the heart is irregular, tumultuous, and loud, and the carotids throb vehemently. After the contractions of the muscles have continued for some time, the convulsions diminish in violence, and at length cease altogether. Perspiration breaks out about the head, neck, and breast; the convulsive respiration is followed by sighs, and the spasms of the muscles by subsultus. The patient then falls into a sleep, from which he awakes either suddenly or gradually. Commonly there is no consciousness whatever of anything that has passed during the paroxysm. On coming out of the fit there is generally headache, and always languor. The convulsive stage may last from one or two minutes to fifteen or twenty, and the sleep from one to several hours. The duration of the whole paroxysm is generally from five to ten minutes; but often two or three attacks follow each other in such rapid succession that the paroxysm seems to be protracted for several hours. Death has sometimes occurred in the midst of a fit, in consequence of injury inflicted on the brain by congestion of the cerebral bloodvessels, or from suffocation; but this event is of extreme rarity, and the chief danger to life lies in the circumstance that a patient may in his fall be fatally injured, or may fall into the fire, into water, &c.

The disease differs according to the slightness or severity of the phenomena, in which there is every possible variety. In the slighter attacks of this disease the loss of consciousness may occur for a few seconds only, and the spasmodic contractions affect but a few muscles of the face and neck. If seized while standing up or even walking the patient rarely falls, and persons often have such attacks during sleep, and wake in the morning without any knowledge of what has taken place.

The return of the regular epileptic paroxysm is exceedingly various in different individuals. Several years may intervene between the seizures, or they may recur once every month, or week, or day. In some instances the paroxysms occur once a week, on the same day; and occasionally every day or night, at the same hour; but they most frequently come on when first falling asleep, and are often for a time unsuspected or overlooked.

Though the epileptic attack usually comes on suddenly, yet it sometimes gives distinct warning of its approach. The symptoms premonitory of an epileptic fit are somewhat akin to those which precede an attack of APOPLEXY. But there is one peculiar sensation, termed the *aura epileptica*, of which many epileptics are conscious immediately before the fit. This consists of a feeling as if something were moving in some part of the limbs or trunk of the body, and creeping thence upwards towards the head. Sometimes it is described as a sensation of a current of air, a stream of water, or a slight convulsive tremor; at other times no distinct idea can be given of the feeling, further than that it is a sensation of something moving along. This remarkable sensation does not appear to follow very distinctly the course of a nerve, but it seems to pass along the integuments. When it reaches the head the patient is instantaneously deprived of sense, and falls down in convulsions. The sensation arises in different parts of the body, in the toe, foot, leg, and groin; in the finger, hand, and arm; at the bottom of the spine; in the uterus, loins, abdomen, and chest. Where this *aura* is felt an attack may often be prevented by tying a handkerchief or band tightly round the limb, and the application of heat, cold, galvanic shocks, &c., to the skin will often have a similar beneficial result. But in the great majority of cases the attack of epilepsy is preceded by no such warning, and even where the premonitory symptoms do exist, the attack does not by any means always follow.

When the disease exists for a long time it is frequently followed by insanity. It often terminates with an attack of apoplexy or paralysis.

Authors commonly divide epilepsy into two species: first, idiopathic, where the disease depends on some primary affection of the brain; and, secondly, sympathic, in which it depends on an affection of some remote part, as the stomach, the liver, the bowels, the generative organs, the circulatory system, &c. The state of the brain on which epilepsy depends is unknown, but many of the causes of the malady are well ascertained, and the knowledge of these is of great importance in the prevention and cure of the disease.

The exciting causes consist of two classes—those which act by exciting the energies of the brain, and those which act by depressing the brain. Those which act by overstimulating the brain are mechanical, chemical, and mental stimulants, and the peculiar stimulus of over-distension, as sharp-pointed ossifications, arising either from the internal surface of the cranium or formed in the membranes of the brain; powerful mental emotions, such as joy and anger; congestion of the bloodvessels of the brain; suppressed discharges; violent exercise; too large a quantity of highly nutritious food or of stimulating drink.

But the very opposite causes, those which manifestly weaken the energy of the brain, occur in epilepsy, as hemorrhage, whether spontaneous or artificial; terror, horror, disgust; any powerful and disagreeable sensations, and especially certain disagreeable odours; excessive evacuations, great fatigue, inanition, and sedative poisons.

The medical treatment of a case of epilepsy must of course differ essentially according as it is idiopathic or sympathic, and connected with a plethoric and robust or debilitated and exhausted state of the system. When the appropriate remedies are judiciously employed, and the proper regimen is strictly adhered to, epilepsy is often permanently cured, and the suffering is greatly mitigated even in those forms of the disease which do not admit of cure.

A patient liable to epilepsy must not be permitted to ride nor to hold the reins in a carriage. The grates in all the apartments which he frequents ought to be guarded by a deep and strong fender; he ought to avoid the streets of a crowded city, in which the whirl of carriages, the tide of human beings, and the multiplicity and distraction of objects produce a vertiginous hurry of thought which to him is ever dangerous. He ought not to walk near water. When an attack of the disease comes on, the patient should be laid upon his back, his collar and necktie should be loosened, and an attendant should stand upon each side to prevent him injuring himself during his struggles. A piece of cork or india-rubber may be placed between his teeth to prevent his tongue being bitten, and plenty of fresh air should be admitted. All attempts to make him swallow or to stimulate the nostrils are improper. As soon as the convulsions cease the patient should be placed in bed, the head and shoulders raised, the former being turned sideways and the tongue drawn forward to promote free breathing, and no other interference should be allowed.

In the treatment of this disease the medicines chiefly relied on are the bromides of potassium and of ammonium in combination with suitable tonics. Sulphate of copper, belladonna, and the preparations of zinc are sometimes

beneficial, and the inhalation of nitrate of amyl has been frequently used with advantage. Strict attention should be paid to diet and regimen, and plenty of exercise taken in the open air, care being taken not to incur great fatigue.

EPILO'BIUM, a genus of plants belonging to the order Onagrarieæ, or Evening Primrose family. In Britain the name Willow Herb is usually given to the whole genus. Thirteen well-marked species occur in Britain. Of these the Rose Bay (*Epilobium angustifolium*) is best known. The stem is from 3 to 6 feet high, with crimson irregular flowers and veined lance-shaped leaves.

The genus is characterized by the tube of the calyx being scarcely, or not at all, produced above the ovary, and the limb being in four parts; there are four petals and eight stamens; the ovary is four-celled, with numerous ovules; the fruit is a many-seeded capsule, opening loculicidally by four valves; the seeds have long hairs at the apex. There are fifty species, natives of temperate and frigid regions throughout the whole world.

EP'ILOGUE (*epilogus*) signifies in Greek a summing up, the end or peroration of a discourse. In English it is applied only to the short poems or copies of verses subjoined to new plays, and recited on the stage at their conclusion.

EPIMEN'IDES was born in the year 659 B.C., in Crete. He passed his youth in solitary retirement. The fable was told of him that he slept in a cave while seeking a lost sheep, and did not awake for fifty-seven years. On returning home he found his father dead and his younger brother an aged man. (The legend of Rip Van Winkle is a copy of this, as is also the ancient myth of the "Seven Sleepers.") Epimenides was one of the seven sages of Greece. The verse of Paul, Titus i, 12, "One of themselves, even a prophet of their own, said, The Cretans are alway liars, evil beasts, slow bellies," records a celebrated invective of Epimenides. It led to the retort that if *all* Cretans were liars, Epimenides himself was a liar, hence his statement was a lie, and all Cretans were not liars; but from this followed that Epimenides might be speaking truly, and if so Cretans were alway liars, &c. There is no escape from the fallacy. He went to Athens at the request of the inhabitants, in order to pave the way for the legislation of Solon by purifications and propitiatory sacrifices. These rites were calculated, according to the spirit of the age, to allay the feuds and party dissensions which prevailed there. Solon's constitution would hardly have been accepted, had it not been recommended and sanctioned by some person who, like Epimenides, claimed from men little less than the veneration due to a superior being. The Athenians wished to reward Epimenides with wealth and public honours; but he refused to accept any remuneration, and only demanded a branch of the sacred olive-tree, and a decree of perpetual friendship between Athens and his own country, Cnossus in Crete, of which he was a citizen. Epimenides visited Athens about 596 B.C., and died soon after his return to Crete.

EPIME'THEUS ("afterthought") was the brother of PROMETHEUS, and the husband of PANDORA in the classical mythology.

EPINAL, the capital of the department of Vosges, in France, stands on the Moselle, 200 miles E. by S. from Paris, and had 14,708 inhabitants in 1881. It is situated at the foot of the chain of the Vosges, and in a district abounding with delightful situations. The clear rapid stream of the Moselle, which here separates into two channels, forming an island, divides the town into three parts—the Grande Ville, which stands on the right bank of the main stream, and at the foot of an eminence surmounted by the ruins of the castle; the Petite Ville, which is built on the island, and is joined to the Grande Ville by two bridges, one of stone built in 1841, and the other an iron suspension bridge; and the Faubourg of the Capuchins, which runs along the left bank of the smaller arm of the Moselle. The streets of Epinal are well built and clean. The finest edifices in the place are—the barracks, the prefect's residence, the college buildings, and the parish church. The former convent of the Capuchins, which stands on an eminence and is surrounded by large gardens, is now used for an hospital. The town has a tribunal of first instance, a communal college, a chamber of commerce, a public library of 20,000 volumes, a museum, orphan asylum, and a theatre. The manufactures are chemical products, lace, paper, and earthenware, block tin, hats, &c. There is also some trade in corn, cattle, iron, timber, oak-staves, deal planks, &c.

EPIPH'ANY (from a Greek word signifying appearance or manifestation), a church festival, celebrated on the twelfth day after Christmas, in commemoration of our Saviour's birth being manifested to the Magi by the appearance of a miraculous star. It is likewise denominated Twelfth Day.

EPIPHE'GUS. See CANCER-ROOT.

EP'IPHYTES are plants found growing upon other vegetables, adhering to their bark and rooting among the scanty soil that occupies their surface, in which respect they are distinguished from parasitical plants, which, like Mistletoe and the various species of Loranthus, strike their abortive roots into the wood, and flourish upon the sap of the individual to which they attach themselves. In this sense of the word mosses, lichens, ferns, and plants of many other families are epiphytes.

EPI'RUS (Gr. *Epeiros*, mainland), a name given to that district in Northern Greece which extended from the Ceraunian Mountains on the north to the Ambracian Gulf on the south, and from the Ionian Sea to the chain of Pindus. The ancient geography of Epirus was attended with great difficulties even in the time of Strabo. The country had not then recovered from the effects of the destruction caused by Paulus Æmilius, in 167 B.C., who destroyed seventy towns and reduced to slavery 150,000 of the inhabitants (Liv. xlv. c. 34; Plut. "Æmil." c. 29), after which the greater part of the country remained in a state of desolation, and where there were any inhabitants they had nothing but villages and ruins to dwell in. It was famous for its cattle and its horses. The inhabitants of Epirus were scarcely considered Hellenic. The population in early times had been Pelasgic. The oracle at Dodona was always called Pelasgic, and many names of places in Epirus were also borne by the Pelasgic cities of the opposite coast of Italy. Theopompus (Strab. p. 323) divided the inhabitants of Epirus into fourteen different tribes, of which the most renowned were the Chaonians and Molossians, who successfully maintained a preponderance. Of the other Epirotic nations the Thesprotians are most frequently mentioned. The Chaonians occupied the northern part of Epirus, the Molossians the southern, and the Thesprotian territory lay in the middle. The most celebrated cities in Molossia were Ambracia and Nicopolis. Ambracia was a Corinthian colony, founded about 650 B.C. Nicopolis was founded by Augustus to commemorate his victory at Actium. The ruins of Nicopolis are very extensive. The modern Albania corresponds in part to Epirus.

EPIS'COPACY. See BISHOP.

EP'ISODE (Gr. *epéisodos*). The Greek word *eisodos*, the principal member of this compound, when applied to the drama means an entrance of the chorus on the stage; *epeisódion*, that part of a play which lies between two choral songs; and as these recitations had, in the rude beginning of the Greek drama, no connection with the choral part, which they were introduced to relieve, the word, with its derivative Latin form, comes to signify a thing connected with, but not essential to, that of which it is a part—which may be taken out and leave a perfect

work; as, for instance, the catalogue of ships in the "Iliad," or the war in heaven in "Paradise Lost." Episodes should grow naturally out of the subject, and when judiciously used they relieve and diversify the main narration.

In music the term has the same relative meaning as in literature. The strict use of the term was at first limited to the episodical matter in *Fugue*, since there the chief source of variety, as distinct from the interest of plan and the culminating intensity which distinguish that supreme form of music, lies in the episodes which connect the more severely fugal parts together. But the use of the term is now extended to a similar introduction of connecting or contrasting matter in any important piece of music; such are the episodes of the Sonata Form, at once separating and connecting the main subjects, and those which divide the several repetitions of the Rondo, &c. The use of episodes is at the present time perhaps exaggerated, for it is occasionally difficult to tell which is subject and which episode in some of the formless rhapsodies of certain contemporary schools. The study of the great masters clearly indicates the true function of this important and charming department of musical composition.

EPISTAX'IS (Gr., a dropping, bleeding of the nose) is the term used by most nosologists to indicate bleeding at the nose, which essentially consists in an effusion of blood externally from the pituitary membrane. Blood may flow from the nose under widely varying circumstances; sometimes when the system is in a state of plethora, and at others when in a state of debility. When it occurs in plethoric persons it is usually preceded by pain in the head, vertigo, or drowsiness, frightful dreams, increased heat of one side of the face, injection of the eyes, flashes of light before the eyes, increased beating of the temporal arteries, deafness, &c. Where the bleeding comes on in a state of debility it is called passive, and may make its appearance without any premonitory symptoms. This form comes on in the course of low and malignant fevers, and various diseases which come on in a cachectic state of the body.

Bleeding at the nose, when it occurs alone, most frequently comes on in children. After ten or twelve years of age it is oftener seen in boys than girls. It is frequently hereditary, and whole families exist who are liable on slight causes to bleed at the nose. It may be brought on by whatever increases the flow of blood to or retards the flow of blood from the head. Bleeding at the nose is not in itself dangerous. It may, however, come on in states of the body when the system is already exhausted, and be the forerunner of a fatal result.

In the treatment of bleeding from the nose regard must be had to the state, age, &c., of the patient. When it occurs in children, and in the great majority of simple cases, all that is required is to make the patient assume the sitting posture, and hold the head backwards. The local application of cold in the form of cold water or ice-compresses to the nose, neck, or forehead is very useful in this affection, or the bleeding nostril may be compressed with the finger of the opposite hand, while the arm of the affected side is raised above the head. In extreme cases the injection of astringents or the operation of plugging the nostril may have to be resorted to. When the person is plethoric and has suffered much pain in the head, singing in the ears, &c., previously, it will not be advisable to stop the bleeding until these symptoms are relieved.

EPIS'TLE is simply the Greek word for letter (*epistolê*), and in common speech means a long and formal letter, as the Epistles of Horace, or our own Pope, and other poets. It is more usually applied to verse than to prose. As used in the New Testament it means a letter written by an apostle to an individual or a church; the *general* epistles were addressed to the universal church rather than to any section or person. In the Liturgy, the first lesson in the Communion Service is called the epistle, because usually, though not always, it is taken from the apostolic epistles. It is read from the south side of the altar, usually therefore known as the epistle side.

EP'ITAPH (Gr. *epitàphium*), an inscription on a tomb. Inscriptions in honour of the dead are perhaps as old as tombs themselves; the most ancient, however, with which we are now acquainted are probably those of Simonides upon Megistias the soothsayer of the little army of Leonidas, and on the heroes who fell at Thermopylæ, preserved by Herodotus (vii. 228). Another epitaph of very high antiquity may be referred to in the ancient Greek inscription found in the Ceramicus at Athens, upon the warriors who fell at Potidæa, 432 years B.C. The original, in a mutilated state, is among the Elgin Marbles in the British Museum.

The earliest epitaphs of this country were those of the Romans or Romanized Britons, which usually began with D. M. (*Diis Manibus*, to the funeral gods), followed by the name, office, and age of the deceased, and a conclusion which informed the reader by whom or through what means the inscription was erected.

Whether the Saxons or the Danes used monumental inscriptions among us, either in their own or in the Latin tongue, has been doubted. The few which we have for the people of the Saxon times are the compositions of a later date. The regular series of English epitaphs begins in the eleventh century, when they were still written in the Latin language, and abundant curious and interesting examples exist from that time to the present.

EPITHALA'MIUM (from the Greek words signifying "at" or "near," and "chamber," especially that of a new-married couple), a poem composed in honour of a marriage. It was sung by youths and maidens conjointly at the door of the bridal chamber, after the bride and bridegroom had entered, and also before they rose in the morning. The most remarkable extant are those of Catullus, who has left three beautiful specimens of this sort of composition. That on the marriage of Peleus and Thetis, which is probably only a fragment, is one of the most beautiful specimens of Latin poetry. One by George Buchanan, on Francis II. and Mary Stuart, is very fine, but the epithalamium of Spenser is the most exquisite English poem of this kind, and is one of the glories of our literature.

EPITHE'LIUM is the tissue which clothes the whole body, both externally and internally. It is composed of cells held together by a small quantity of cementing intercellular substance.

Externally it forms the epidermis [see SKIN], the NAILS, and the HAIR, changing its apparent but not its real characteristics as it passes within the various orifices of the body. Substantially the internal epithelium of the whole alimentary, genito-urinary, and respiratory tracts is the same as that epidermis which seems to the eye to differ so much from it. Epithelium also lines the cavities of the brain and the central canal of the spinal cord, the serous and synovial membranes, and the interior of all blood-vessels and lymphatics; in fact, as said above, it clothes the body within and without. Epithelium is sometimes *simple—i.e.* one cell thick—as in the alimentary tract from the stomach to the anus, in the vesicles of the lungs, &c.; sometimes *laminated*, or several cells thick, as in the epidermis. It has great power of accommodation in the simple form, as indeed is obviously necessary for organs like the stomach and intestines, whose surface is hardly of equal size two hours together, and is still more essential for the momentarily varying lungs and arteries.

The forms of epithelium cells are four—squamous, spheroidal, columnar, and ciliated.

Squamous epithelium is also called scaly, pavement, or tesselated epithelium. It is composed of squamous (scaly) cells, as in the familiar example of the outer layers of the

epidermis or false skin, and becomes densely laminated and horny in parts which have much wear, as the feet and the palms of workmen's hands, &c. As a single layer squamous epithelium often occurs, as in the interior of the heart and bloodvessels, where it presents such special features that it is usually called by a distinct name, ENDOTHELIUM. The forms of the cells are very irregular. If the dried cast-off scales of epithelium from the epidermis be examined their character can hardly be recognized until treatment with caustic potash, when they swell out into ordinary spheroidal form and frequently show a clear nucleus. In the case of the CHOROID squamous epithelium contains minute molecules of pigment (*melanin*).

Spheroidal epithelium, with large free cells, is the form of the tissue seen in the great secreting organs, particularly developed in the salivary glands and the kidneys.

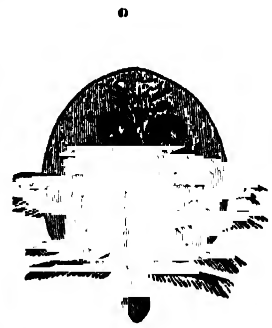
Columnar epithelium is that which lines the alimentary tract in a simple (one cell thick) tissue from stomach to anus. The cells are packed close together, and are elongated to a cylindrical form having a large oval nucleus; in fact it is sometimes called cylindrical epithelium. If occurring in more than one layer the inner layers of columnar epithelium often depart rather widely from the normal type, presenting fusiform, spindle-shaped, or other outlines.

Ciliated epithelium is, as its name implies, covered with fine cilia or hair-like processes on its free surface. It is almost always columnar, but is sometimes found squamous in shape. This is the form of epithelium so characteristic of the respiratory tract, sweeping the mucus outwards from the bronchial tubes with a constant wave-like lashing motion of the tiny cilia, some twenty or thirty of which are usually mounted on each cell. [See CILIA.] Several other parts of the body, as the nose, the central canal of the spinal cord, &c., are lined with ciliated epithelium.

The almost purely protective function of the external epithelium has superadded to it, then, in the interior of the body the functions of motion, of secretion, and of sensation, as in the examples of the epithelium of the nose, of the intestine, and of the eye, ear, &c. Its last function causes special adaptations, as the rods and cones of the eye, the olfactory cells of the nose, the peculiar cells of ciliated epithelium in the vestibule and in the organ of Corti in the ear, &c. In every case, however, external or internal, one property is common to epithelium: it is constantly being shed and as constantly being renewed. This is particularly well shown in the nails, hair, and skin, but is just as true of the moist varieties of epithelium.

EPIZO'A (Gr. *epi*, upon; *zoa*, animals) is a term used for animals parasitic on the exterior of the bodies of other animals, as opposed to entozoa or internal parasites. The name is specially applied to a group of deformed crustaceans parasitic on fish and other inhabitants of salt and fresh waters. In external appearance they resemble none of the CRUSTACEA. It is probable, however, that though often made a separate subclass of that class, they should be placed among the order Copepoda of the subclass ENTOMOSTRACA, finding a near relation in the beautiful CYCLOPS. Their extreme degradation is due to their parasitic habits, not to inheritance. The young are free-swimming and closely resemble the young Cyclops. They are provided with very well developed swimming organs and eyes. The annexed cuts show the types of two groups into which the Epizoa are divided. Argulus and its allies in the adult state retain their locomotive organs; besides these four pairs of limbs, three pairs of mouth appendages are found, and two pairs of antennæ, the second of which is modified into hook-like clasping organs. *Argulus foliaceus* is found in England on the stickleback, pike, and some other fishes. The genus Caligus is the type of the marine fish-lice found on cod and salmon. The group of which Lernæa is the type is still more degenerate. These animals have become fixed parasites. The limbs lose their locomotive functions entirely, and in some cases serve as attachments. In other cases the parasite is attached to its prey by means of processes growing from the anterior part of the body. The mouth appendages are mere pricking organs; in some cases

Lernæa branchialis.



Argulus foliaceus.

they are modified to form a suctorial mouth. In the genus Achtheres, parasitic on the perch, the maxillæ are large claws which, piercing the skin of the fish, meet one another and grow together. These creatures are found on the gills and other parts of fishes. They have external ovisacs like Cyclops. The males and the young females are free-swimming and resemble Copepods.

E'POCH, a fixed point of time from which chronology may be reckoned. [See CHRONOLOGY.] Or it may stand for the era reckoned from such an epoch, in common speech. This term is frequently applied in astronomy to signify, not a moment of time, but the longitude which a planet has at that moment of time. In order to predict the longitude of a planet at any epoch, some preceding epoch must be taken at which the longitude is known. This latter is especially called the epoch; and the term *longitude at the epoch* has been abbreviated into *epoch.*

EP'ODE (in Gr. *epôdos*, after-song) is one of the three divisions of the Greek ode. The performers swayed hither in their dance during the strophe ("turn"), thither during the antistrophe ("counter-turn"); in singing the epode (or, as Ben Jonson calls it, "the stand") they stood still. It was not, like the strophe and antistrophe, symmetrical with another member of the ode, so that it was unfettered as to its length and as to the choice of measures. The epode, however, is not essential to an ode; many of the Greek choruses have none. Most of Pindar's odes, on the contrary, have an epode interposed between each antistrophe and the following strophe. Epode, according to the grammarians, is also a metrical term given to those measures in which a short verse follows a long one, of which the former is called *proödic*, the latter *epodic.* Hence the fifth book of Horace's Odes is called the Book of Epodes, because nearly all of them are written in that sort of measure.

EP'PING, a market-town of England, in the county of Essex, 17 miles N.N.E. from London. It is called Epping Street, is about half a mile long, and contains 2848 inhabitants. There are a chapel-of-ease, an Independent chapel, national and other schools, musical and literary societies, and a town-hall. Epping gives name to the large tract of waste land in the south-western part of the county called Epping Forest. The extent of the forest is estimated at 60,000 acres, of which about 55,000 are inclosed and private property, the remaining 5000 being uninclosed wastes and woods. It consists of nearly

18 miles of almost unbroken woodland scenery, forming perhaps the most extensive pleasure-ground in Europe. It is an interesting fact that the white-tailed eagle has occasionally been found here. The process of inclosure was proceeding so rapidly that a special Act was passed in 1871 to restrain it, and in 1874 the inclosures were declared illegal, and the greater part of the area inclosed since 1851 was again thrown open. Another Act passed in 1878 defined the rights of the public in the forest, and also its management, which is now in the hands of a committee of the corporation of the city of London, by whose efforts the valuable acquisition had been secured to the people, and four verderers, the latter being elected by the holders of county franchise in the neighbouring parishes. In 1882 Queen Victoria visited Epping Forest, and declared it the possession of the public for ever.

Epping Forest formed part of the ancient forest of Waltham, and is full of historical interest. It was between the towns of Epping and Waltham that Queen Boadicea, having defeated the Romans at Colchester, was vanquished by the imperial troops and escaped only to die of grief or of poison. It was the favourite hunting-ground of English monarchs from very early times, and a legend tells that Elizabeth once rode her horse up the broad staircase of the old hunting lodge of Chingford into the dining room. The title of lord warden of the forest was, until recently, hereditary in the family of the earls of Mornington. The Epping hunt, which dated its origin from early in the thirteenth century and was formerly held on Easter Monday, near Buckhurst Hill, was for many years the chief Cockney fête, and divided with Greenwich Fair the attention of the pleasure-loving public of the east end of the metropolis. It was always supposed that the lord mayor and aldermen of London had a hereditary right to hunt over this part of the royal forest. The celebrated Fairlop oak, which measured 45 feet in girth, was blown down in 1820.

EP'SOM, a market-town of England, in the county of Surrey, about 18 miles from London by the Brighton and South Coast, and 14 by the South-western Railways, and 16 miles by road, is celebrated for its annual races, the Derby and the Oaks, held in May, which attract hundreds of thousands of visitors of all classes, and its mineral springs, whence the Epsom salts derive their name. The manufacture of salts from the Epsom springs has been abandoned on account of the ease with which they can be made artificially. The old well is on the Epsom common to the right of the road to Ashstead. As a watering-place Epsom was in great vogue during the reign of Charles II., who frequently visited it, and it maintained its popularity until about 1720. The races became famous in 1779. In the market-place stands a handsome clock-tower of original design. The Royal Medical Benevolent College is a spacious Tudor building north of the town. It has accommodation for decayed medical practitioners, and a school for the sons of medical men and general pupils. Epsom has of late years been much improved and a good supply of water obtained. It is the residence of many persons of the middle class employed in London during the day. The town has a good general trade, and there are some rather extensive breweries and malt-houses, brick-kilns, and nursery gardens. The neighbouring downs afford many delightful prospects. Population, 6916.

EP'SOM SALT, the popular name for the sulphate of magnesia, originally derived from its discovery in 1675 in the water of a spring at Epsom. It is now usually procured by the action of dilute sulphuric acid upon dolomite, a magnesian limestone. Immense quantities of this stone exist in England, sufficient, it has been cheerfully observed, "to purge the whole human race for centuries to come."

It forms a mild but efficacious purgative, and is much used in household medicine. The doses vary from two drachms to an ounce, according to the effect required. It acts best when taken fasting and largely diluted with water.

EP'WORTH, a town of England, in the county and 28 miles N.N.W. of Lincoln. The inhabitants are chiefly employed in the culture and manufacture of flax. It is a small place, but is famous as the birthplace of John Wesley in 1703.

EQUAL. Two magnitudes are equal when one of them may be made to coincide with the other. This is the geometrical definition of Euclid, and is placed by him among the axioms, though in reality it is nothing more than a definition of the word equal.

EQUALITY, APPROACH TO. As a general rule, that which may be stated as absolutely true when an equation is true, may be stated as nearly true when that equation is only nearly true. Usage of words, however, is apt to lead to mistake when it is equality, and nearness to equality, which are in question: A and B are absolutely equal when either of the following equations is true; one of them being of course a consequence of the other:—

$$A - B = 0, \qquad \frac{A}{B} = 1,$$

and it is usual to say that a *small* quantity is *nearly nothing* or *near to nothing*. In strictness we might as well say that a large quantity is near to infinity as that a small quantity is near to nothing; both infinity and nothing are limiting terms, except only as to the latter when obtained by subtraction. Nevertheless we can hardly hope to abolish the common idea of small quantities being next to nothing. We must therefore guard those who accept this phraseology from the mistake to which it very frequently leads.

It is not true that quantities are necessarily nearly equal when their difference is near to nothing (meaning small). If by small we here understand small with respect to the quantities themselves, it is true; but not otherwise. If $A - B$ be a small fraction of A, let it be mA, where m is a small fraction of unity; then $A - B = mA$ gives

$$\frac{B}{A} = 1 - m,$$

or B and A are in the ratio of $1 - m$ to 1, nearly that of 1 to 1. But if A and B be both small, their difference is small; and yet that difference may be itself many times greater than the smaller of the two quantities from which it was obtained. If the bulk of the sun be unity, the earth and moon are both small fractions, but not nearly equal. When therefore we want to think of approach to equality, we must rely on the approach to

$$\frac{A}{B} = 1, \quad \text{not to} \quad A - B = 0.$$

EQUA'TION, in pure mathematics, is an assertion of the equality of two magnitudes, represented to the eye by the symbol $=$. Thus $A = B$ is to be understood as a proposition, declaration, or assertion that the magnitude A is equal to the magnitude B. It is not immaterial to insist upon this definition, for beginners frequently confound the notion of an equation (an *assertion* of equality) with the idea of equality itself, and speak of two *equations* being *equal*, or of multiplying or dividing an *equation*.

To treat of equations is to write on mathematics in general; for when two magnitudes, A and B, are of the same kind, A must either be greater than, equal to, or less than B. The objects of mathematics generally require that it should be determined (supposing A and B not equal) by how much one exceeds the other; and the assertion that A exceeds B, and exceeds it by m, is equivalent to the *equation* $A = B + m$. The assertion of inequality is called by some continental writers an *inequation*.

An equation may be one of two kinds—necessarily true whatever may be the value of the symbols employed, and called *identical;* or true only upon the supposition of some particular value being given to certain magnitudes, or of some particular relations existing. The latter species are called equations of *condition.* Thus—

$$a = a, \quad a + a = 2a, \quad (a + b)^2 = a^2 + 2ab + b^2$$

are identical equations, while

$$2a + 1 = 13, \quad x^2 = 5x - 4$$

are equations of condition; the first requiring that a should be 6, and the second that x should be either 4 or 1. Again, $a + b = 1$ is an equation of condition.

EQUATION, in astronomy. The characteristic of all the heavenly motions is, that they nearly follow a simple law, but not quite. The small corrections which must be added to or subtracted from the results of the simple law, in order to secure accurate prediction, are called equations. Thus, the moon moves round the earth with a motion which is not very far from uniform; the average motion is therefore ascertained, and starting from a given epoch, at which the true place is known, the longitude for that epoch is first increased by the longitude which would have been described by the moon, had she moved with her average motion. The result must then be altered by a number of different equations, some being consequences of the elliptic figure of the moon's orbit, some of the sun's attraction, &c. When all these equations have been annexed, the result is the moon's longitude for the time proposed.

EQUATION TO A CURVE is any equation between CO-ORDINATES (usually rectangular ones) which is true at all points of the curve.

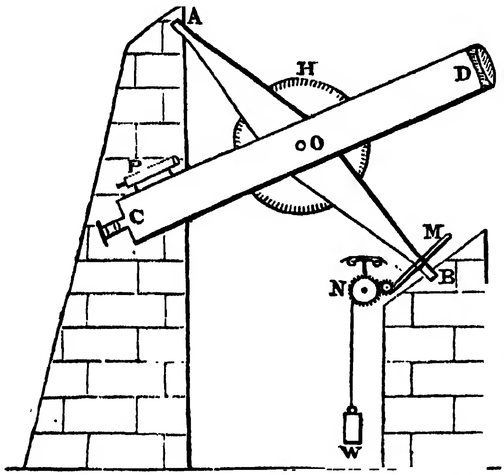
EQUATION, PERSONAL. Different persons, attempting to observe the precise moment of a phenomenon, by means of a clock which beats seconds, do not agree exactly in their results, but differ generally in one and the same way, one of the observers being almost always a little before the other in the moment which he assigns to the phenomenon. Physical constitution, temperament, habit, &c., make these differences between one and another. *Personal equation* is a name given to the quantity of time by which a person is in the habit of noting a phenomenon wrongly; and it may be called positive or negative, according as he notes it before or after it really takes place. Thus if A and B are severally in the habit of noting events 3-10ths of a second after and 4-10ths of a second before they take place, their personal equations may be described as being $+ 0^s\!\cdot\!3$ and $- 0^s\!\cdot\!4$.

The first notice we have of personal equation is an announcement by Maskelyne, in the volume of Greenwich Observations for 1795. He tells us that he was obliged to part with one of his assistants, because the latter, who had till then always agreed with him in his observations, suddenly began, in August, 1794, to observe half a second later; and that in January, 1796, the difference amounted to 8-10ths of a second. The phenomenon has since been attended to, and is now looked for and provided against.

EQUA'TOR. The word equator bears two different meanings—one relating to the earth, the other to the heavens. The terrestrial equator is a great circle surrounding the earth. It is defined by the intersection with the surface of the earth of a plane drawn through the centre of the earth, perpendicular to the axis about which the earth rotates. The equator is thus the great circle on the earth, every point of which is 90° from the pole. If we imagine the plane of the terrestrial equator produced until it cuts the celestial sphere, the great circle produced by that intersection is the celestial equator. An observer stationed on the terrestrial equator will have the celestial equator passing through his zenith and the pole in his horizon. All the stars will rise perpendicularly from the horizon, and every star will remain above and below the horizon for an equal time (neglecting refraction). An observer stationed at the terrestrial pole would have the celestial equator on his horizon. Each star would describe an horizontal circle around the heavens, and the phenomena of rising and of setting would be unknown. We have already explained [see ECLIPTIC] how the path of the sun is determined. The intersections of the ecliptic and the equator are two points of very great importance in astronomical measurement. They are known as the equinoxes. From the vernal equinox, through which the sun passes in spring, the right ascensions are measured, so that a sidereal clock properly rated should show 0 hours 0 minutes 0 seconds when the vernal equinox crosses the meridian.

EQUATO'RIAL, a term used in astronomy to denote a telescope mounted in the manner which renders it suitable for continuous observation by enabling a star to be followed easily in its diurnal motion. If the earth were fixed so that the heavenly bodies remained hour after hour in nearly the same direction, the use of telescopes for certain purposes would be greatly simplified. The telescope being once directed to the star, the observer could continue observing the star as long as he desired while the telescope remained fixed. Owing to the diurnal movement of the heavens this is not possible, the star speedily moves out of the field of view, and the telescope has to be moved also if further observation be desired. Nor is it always easy even to point a telescope at a star without being aided by special contrivances. An observer who had a large telescope, mounted in the best manner, might spend much time before he could get the telescope even pointed on Sirius. If he had not the aid of graduated circle or a "finder," the difficulty would become greatly enhanced when it was desired to point out some very faint object like the planet Neptune, which cannot be seen by the unaided eye. It follows that in using a great telescope we must have some means of pointing the telescope to the object, and then of moving it so as to follow the object. We refer to the article TELESCOPE for a description of the optical part of the instrument. What we have now to consider is the mechanical means by which the movements of the telescope are guided. The general principle of the equatorial is exhibited in the sketch on next page. C D is a telescope, which consists in this case of a tube with an achromatic object glass at one end, D, and a compound eye-piece of two lenses at the other, C. The telescope is supported at its centre, O, by the *polar axis*, A B, but the telescope is still able to rotate freely about the axis through O, which is called the *declination axis.* The polar axis is supported at its extremities, A and B, in fixed bearings, which are secured in solid masonry, but the polar axis admits of being turned round so that the telescope has really two degrees of freedom by the rotation of both the polar axis and the declination axis. The instrument can thus be pointed to any part of the heavens. In this respect, however, an equatorial is no better than an ordinary altitude and azimuth instrument; the peculiar excellence of the equatorial depends on the special positions in which the axes about which it turns are adjusted. The polar axis, A B, is to be placed parallel to the axis of the earth; it is consequently always directed at its upper end towards the north pole, while its inclination is equal to the latitude. At the equator the polar axis of an equatorial would be horizontal, at the pole the polar axis would be vertical. The instrument shown in our figure is intended for a latitude of about 40°. As the star in its diurnal path describes a circle round the pole, it appears that once the telescope has been pointed to the star we can follow the star by merely turning the telescope round the polar axis without any change of the declination axis. In this lies the utility of the equatorial. We have only a single rotation

to provide in order to follow the stars. The movement in declination is for the purpose of pointing the instrument towards any particular star. To enable this to be done with precision, the declination axis is furnished with a graduated circle, H, so that when the declination of the object is known the telescope can be at once *set* to the proper declination. The polar axis is also furnished with a graduated circle, M, divided in this case into hours, minutes, and seconds. We are thus able to point the instrument at any given hour angle from the meridian, so that by means of these ten circles any object of which the right ascension and declination are known can be at once brought into view. It will be observed that the rate at which the polar axis must revolve, so as to follow the star, is quite independent of the place of the star. The polar axis merely revolves as if it were rigidly attached to the celestial sphere. The uniformity of this movement enables it to be performed by clockwork. In the figure a weight, W, sets in motion a train of wheels, N, which work a tangent screw by which the wheel, M, is rotated. A vertical spindle is also rotated by the mechanism. This spindle



carries a pair of governor balls, which fly out if the rate be too quick, and thus produce friction, which acts as a control. Once the telescope has been pointed to a star and the clock has been set in motion, the instrument will follow the star, and except that the observer has to move his seat occasionally to accommodate himself to the changing position of his instrument, he may be unconscious of the diurnal motion. At P is a *finder*, which is a very useful adjunct to an equatorial. The finder is a small telescope with an axis parallel to that of the large one. The field of the finder being much greater than that of the great telescope, we can at once direct the finder to any star, and then moving the whole instrument so as to bring the star into the centre of the finder, we find it visible in the great telescope.

The equatorial figured in the sketch is of the type known as English, in which the polar axis is very long. It is now more usual to mount equatorials in the German fashion with a short polar axis, which involves other corresponding modifications. The greatest equatorial refractor which has yet been constructed is the Vienna telescope, made by Mr Howard Grubb, of Dublin, with an object glass 27 inches in diameter. Very nearly equalling this is the instrument of the United States Naval Observatory at Washington with an aperture of 26 inches. There are perhaps twenty or twenty-five telescopes in existence with an aperture exceeding 12 inches. The reflecting telescopes are much larger than refractors of equal power, but their reflectors have been made on such a colossal scale that the most powerful instruments in the world ought to be the great reflectors. At the head of the list stands the great reflector of Lord Rosse, with 6 feet of aperture. If we are to judge of the excellence of contemporary telescopes by the work which they have achieved, then the palm must be given to the great Washington refractor. In the skilled hands of Mr. Asaph Hall this instrument made the most brilliant telescopic effort of the present century. We allude, of course, to the discovery of the satellites of Mars. See MARS.

EQUATORIAL CURRENT. See ATLANTIC OCEAN.

EQUES'TRIAN GAMES, horse-races among the Romans, of different kinds, as the *prodromus*, or simple horse-race, the decursory race around funeral piles, chariot races, the Neptunian games, &c.

EQUES'TRIAN ORDER. See EQUITES.

E'QUIDÆ is a family of UNGULATA, a division of which, PERISSODACTYLA (the odd-toed ungulates), is represented to-day only by the rhinoceroses, tapirs, and the Equidæ or horses. There is only one genus now existing Equus, containing the horse, ass, zebra, &c. (see Plate). This genus presents several well-marked characters, and was at one time regarded as a distinct order under the name Solidungula, characterized by the circumstance of their possessing, or rather appearing to possess, only a single toe, which is incased in a solid box-like hoof; there are, however, on either side of this large central toe two "splint bones," which are rudiments of the second and fourth metacarpal and metatarsal bones of the typical pentadactyle foot. Another distinguishing feature is seen in the dentition, which is made up in the adult male of forty teeth, in the female usually of only thirty-six. Twelve of these are incisors, six in each jaw; they have in youth their crowns hollowed by a pit which extends to a certain depth in the crown, and becomes obliterated as the tooth wears away, and by noticing the condition of this pit a horse's age may be judged. There are six molars on each side above and below, three of them premolars and three true molars; a rudimentary fourth premolar is sometimes developed, but generally falls out when maturity is reached. All the molar teeth have a square crown, showing four crescentic pits, besides which, in the upper teeth is a little disc on the internal edge. The males, moreover, have two small canine teeth in both jaws; these are almost always wanting in the females. The full dental formula is thus:—*i.* $\frac{3}{3}$, *c.* $\frac{1}{1}$, *p.* $\frac{4}{4}$, *m.* $\frac{3}{3}$, on each side = 44 in all. Between the canines

Skull of the Horse.

and the first molar is a vacant space which corresponds to the angle of the lips; it is here that the bit is placed, by means of which alone man has come to subdue these vigorous quadrupeds. The stomach is simple, and of moderate size; but the intestines are very long, with an enormous cæcum. The teats are inguinal.

The recent discoveries in North America, in formations of the Tertiary period, of forms referable to this family show the highly specialized character of the existing genus Equus, more especially as regards the limbs and the dentition. The most ancient form of horse is of Eocene age, and is named by Professor Marsh Eohippus. In this

little animal, which is only as big as a fox, we see the first step from the typical five-toed foot to the single hoof of the modern horse. Eohippus had four well-developed toes and a rudiment at the first toe. In Orohippus, another Eocene form, this rudimentary pollex is no longer apparent. It was succeeded in the early Miocene period by Mesohippus, with four toes, one of which, the fifth digit, has dwindled away almost to nothing. A little later we get animals as big as sheep, Miohippus and Anchitherium, with three well-developed toes, all touching the ground. In Pliocene times the horses, as represented by Hipparion and Pliohippus, have become much larger and got much further in their development. The two outer toes, that is, the second and the fourth, have so dwindled as to be no longer functionally useful. From this the transition is easy to Equus, in which these two toes, still further reduced in size, are known as the splint bones. The teeth have undergone changes not less interesting. The Eocene and Miocene forms have the complete forty-four teeth well-developed. The molars have undergone great modifications, and their crowns have considerably lengthened. The pit of the incisors is first seen in Hipparion. Fossil species of the genus Equus have been found both in Europe and America, in which latter continent they became extinct, the herds of wild horses existing there now being descendants of those introduced after the Spanish conquest. Of the existing species of the genus Equus, the most important are the HORSE, ASS, ONAGER, KIANG, QUAGGA, and ZEBRA, which will be noticed under their respective headings.

EQUILIB'RIUM (Lat. *æqua libra*), a state of rest produced by the mutual counteraction of two or more forces. The science of equilibrium is STATICS.

EQUIMUL'TIPLES, multiples in which equal numbers of times are taken. Thus *seven* times A and *seven* times B are equimultiples of A and B.

EQ'UINOXES, the intersections of the equator and the ecliptic, the vernal equinox being that in which the sun is when about to rise into the northern hemisphere, and the autumnal equinox that in which the sun is when about to sink into the southern hemisphere. These terms are relative, for the equinox which is vernal in our hemisphere is autumnal in the southern, and *vice versâ*. The *precession of the equinoxes* is one of the most interesting problems connected with astronomical science, and can only be satisfactorily accounted for by the supposition that the sun himself, with all his revolving orbs, is in constant motion, and describing some great circle in the heavens, which he performs, according to the usual calculations, once in about 25,000 years. The history of this discovery can be traced back for upwards of 2000 years. By a series of observations made at Alexandria, between the years 161 and 127 B.C., Hipparchus found that the point of the autumnal equinox was about 6° to the eastward of the star called Spica Virginis. Eager to determine everything by multiplied observations, he ransacked all the Chaldean, Egyptian, and other records to which his travels could procure him access for observations of the same kind. He found some observations of Aristillus and Timochares, made about 150 years before. From these it appeared evident that the point of the autumnal equinox was then about 8° east of the same star. He discusses these observations with great sagacity and rigour, and on their authority he asserts that the equinoctial points are not fixed in the heavens, but move to the westward about 1° in seventy-five years. This motion is called the "precession of the equinoxes," because by it the time and place of the sun's equinoctial station precede the usual calculations. It is fully confirmed by all subsequent observations. In 1750 the autumnal equinox was observed to be 20° 21′ westward of Spica Virginis. Supposing the motion to have been uniform during this period of ages, it follows that the annual precession is about $50\frac{1}{3}''$; that is, if the celestial equator cuts the ecliptic in a particular point on any day of this year, it will, on the same day of the following year, cut it in a point $50\frac{1}{3}''$ to the west of it, and the sun will come to the equinox 20′ 23″ before he has completed his round of the heavens. Thus the equinoctial or tropical year, or true year of the seasons, is so much shorter than the revolution of the sun or the sidereal year.

EQUISETA'CEÆ, a group of flowerless plants. [See CRYPTOGAMIA.] They are called in England Horse-tails, and are considered a sure sign of a wet, stiff, springy soil. There is only one genus existing, Equisetum. The stems are employed in the shops under the name of Dutch rushes. They have a deposit of silex in the cells of the epidermis, which gives them the hard surface that makes them useful for the polisher's purpose. In *Equisetum hyemale* there is so much silex that the ashes form a good polishing powder, like fine tripoli.

The underground stems (rhizomes) are jointed and solid; from them shoots spring up at intervals bearing whorls of scale-like leaves at their joints, and sometimes branches. The erect shoots or stems are hollow, and are longitudinally marked with numerous small furrows. They are either barren or fertile. The fertile stems are club-shaped at the top, the club consisting of a short axis covered thickly with bodies shaped somewhat like a mushroom. These bear on the under side a circle of tooth-like pouches, with a slit on the inside (the sporanges), whence the reproductive bodies or spores fall when ripe. The spores have two short threads (elaters) united by their centre, and attached there to the spore. They are coiled spirally round the spore, and, in fact, are the outermost coat of the spore. When the spore falls from the sporange, the elater uncoils with elasticity when the air is dry, but as soon as the air becomes damp they again coil round the spore.

EQUISET'IC or **ACONIT'IC ACID**, an acid found in several species of the plant Equisetum or horse-tail in the form of magnesium and calcium salts. It is also found in *Aconitum napellus*, or monkshood, as a calcium salt. It is an uncrystallizable amorphous body, very soluble in water, alcohol, and ether. It is tribasic, and forms a variety of crystalline salts with alkalies, alkaline earths, and metals. The formula is $C_6H_6O_6$. It may also be obtained from citric acid by decomposing it with heat.

EQUISE'TUM, a genus of plants, the type and only genus of the order EQUISETACEÆ. *Equisetum hyemale* (Dutch rush) has a simple stem, very rough, with from fourteen to twenty slender furrows. It is a native of England, Scotland, and Ireland, as well as the continent of Europe; but is almost unknown in the middle and southern English counties. It appears to possess tannin, and to act as an astringent. It is supposed to be injurious to cows, but horses eat it with impunity. This plant, more than any other species, is used for the purpose of polishing wood, bone, ivory, and various metals, particularly brass, and is brought into this country from Holland, where it grows abundantly, and is sold in the shops of London under the name of Dutch rush.

Equisetum variegatum is found on sands near the sea, or wet places in the British Isles. *Equisetum palustre* is very generally distributed over the British Isles. It is liable to alter its characters, and three tolerably permanent varieties have been described. *Equisetum maximum* (water horse-tail) is one of the most beautiful of the species, attaining a height of 3, 4, and even 6 feet. It is abundant in the neighbourhood of London, especially near Hampstead Heath. It is a native also of the more southern countries of Europe. *Equisetum limosum* is seen very commonly in ponds and ditches, and sometimes in running streams, the roots and a portion of the stem being immersed in water. It is a common plant throughout Europe. Linnæus says that in Sweden it is used as food for cattle, in order that

cows may give more milk, and also that the reindeer feed on it. He advises that it should be collected in summer as fodder for the winter. Cattle in this country will sometimes eat it. *Equisetum sylvaticum* (wood horse-tail) is found in wet shady places and moist woods throughout Great Britain. *Equisetum arvense* (corn-field horse-tail) is the most common of all the species, and frequently a source of serious injury to the farmer and gardener.

EQ'UITES (Lat., knights), the name of an order in the Roman state. The equites were originally a class of men of rank who served on horseback. There were said to be, in the earliest periods of Roman history, three centuries or bodies of equites, but all that relates to the origin of the equites is very obscure. Tarquinius Priscus is said to have established three more centuries.

When Servius Tullius established the comitia of the centuries, he added twelve other equestrian centuries. To the establishment of the comitia centuriata the creation of the body of equites as a distinct order seems to be due. According to the Servian constitution, good birth or the sanction of the censors was necessary for gaining a place in the equestrian order. It appears probable that a certain sum (eventually 400,000 sesterces) was fixed, the possessor of which was obliged to serve on horseback at his own expense if no horse could be given him by the public, and that those whose fortune fell short of this were obliged to serve in the infantry under the same circumstances.

The lieutenant of the dictator was called "the master of the equites" (*magister equitum*), and in later times he was appointed to this office by the dictator himself. Actual service in the state cavalry gradually came to be monopolized by the young aristocracy, sons of senators, &c.; but the equestrian order, on account of the money qualification, came, as Rome grew wealthy, to be almost synonymous with the capitalist class. Caius Gracchus saw the use that might be made of such a body, and gave them great powers in the state.

With regard to the functions of the equites as an order they had to act as judices or jurymen in certain kinds of trials, under the Sempronian law (of Caius Gracchus); under the Servilian law the judices were chosen from the senate as well as from the equites; by the Glaucian law the equites alone performed the office, and so on by alternate changes till the law of Aurelius Cotta (B.C. 70), by which the judices were chosen from the senators, equites, and *tribuni ærarii*. The equites also farmed the public revenues. Those who were engaged in this business were called the *publicani* (the "publicans" of the New Testament).

They had particular seats assigned to them in the circus and the theatre. The insignia of their rank (in addition to the horse of those actually serving in the cavalry) were a golden ring and the *angustus clavus*, or narrow band, on their dress, as distinguished from the *latus clavus*, or broad band, of the senators; the two last insignia seem to have remained after the former ceased to possess its original character.

EQ'UITY. For many hundreds of years prior to November, 1875, equity formed a distinct branch of English law, and was administered in the High Court of Chancery, the courts of common law having separate and widely differing jurisdiction. At the date alluded to, however, the Judicature Act of 1875 came into operation, and by this the distinctive equity jurisdiction of the Court of Chancery was terminated, the various judicial courts were combined into one High Court of Justice, and equity as well as common law jurisdiction was vested in each division of the High Court. [See JUDICATURE ACT.] The rise of our former great equity court has already been traced under CHANCELLOR, so that we shall here only point out the chief reasons which led to the separation of equity from common-law jurisdiction, and this will afford the best definition of equity itself as a branch of English law.

Courts of law at a very early period adopted the practice of simply deciding upon distinct issues submitted to them, and this only upon established rules, the hard and fast application of which often rendered it impossible for a law court to do justice in a cause. And when the cases became numerous in which the fixed forms of remedies applied by the law courts did not apply, such cases gave full occupation to the Court of Chancery, whence they were sent for relief, and hence the "equitable" jurisdiction of that court, as it was called, though it was in truth quite as much a legal jurisdiction as the common law.

The exclusive jurisdiction of the Court of Equity was chiefly exercised in cases of merely equitable rights, that is, such rights as were not recognized in courts of law. Most cases of trust and confidence fell under this head. But many of the cases, however, carried into the Equity Court in early times were taken there more as appeals from the practical injustice of the law courts than as new cases. For instance, a rule of common law was that payment of a bond debt could not be proved unless by an acquittance under seal. This was not, however, it was said, the law; it was simply a rule of the courts of common law as to proof. The party therefore went into the Court of Chancery for relief, and the relief was called "equity," but it was simply good law—as was proved by the fact that the common law courts presently dropped their rather stupid rule, and equity and law on the subject were acknowledged to be the same; the decision in equity, in fact, became the new rule in law.

In reviewing the rise of the Court of Chancery, we have already pointed out that in early times the office of chancellor was filled by an ecclesiastic, and when clerical chancellors began to review common law decisions they probably acted on somewhat loose, if in the main correct, notions of right and wrong. At first they dealt only with cases of gross and flagrant injustice, about which there was no difficulty. But gradually and imperceptibly the cases of equity in which they were asked to interfere grew more complex, and until definite rules had been framed and settled the most upright of men might differ in their equity decisions. Hence Selden's celebrated sarcasm: "Equity is a roguish thing; for law we have a measure. Equity is according to the conscience of him who is chancellor, and as that is larger or narrower so is equity. It is all one as if they should make the standard for the measure we call a foot a chancellor's foot."

Only in course of time did this ground of reproach cease Like other tribunals, the Court of Equity became bound by statute and precedent. Such a result was to be anticipated when chancellors were chosen, not from the dignified clergy, but from men learned in the law, and consequently alive to the manifold evils of making the law vague and variable. Lord Ellesmere, who was lord keeper under Elizabeth and lord chancellor under James I., led the way in this direction. Under him equity took form and shape as an integral part of jurisprudence, governed, no less than the common law, by fixed principles and definite rules. By him also the power of the Equity Court to control, restrain, and practically to overrule judgments at law, whose operation would have been inequitable, was most resolutely and completely vindicated.

It was on more than one occasion declared by Parliament that the Court of Chancery should not exercise jurisdiction in any matter determinable at common law, and this cardinal rule was only so far relaxed that the court could entertain jurisdiction in cases in which, though determinable at common law in the sense of being within the jurisdiction of courts of law, these courts could not, from the defect of their procedure or remedies, afford adequate redress. Courts of common law could proceed by certain forms of action alone, and gave relief only by a general and unqualified judgment for the plaintiff or the

defendant. There are many cases, however, in which a simple judgment for either party would not do entire justice, and in such cases the common law courts were powerless, while an Equity Court could bring before it *all* the parties interested in a suit, determine the rights of all, however numerous, and could modify or annex conditions to the exercise of rights or the redress of injuries. Moreover, in an action at common law a party could not have discovery of evidence in his case in his adversary's knowledge and possession, and it was originally of the essence of equity jurisdiction to give it; for the great feature of the chancery system of procedure, and that of which the greatest jealousy was felt on account of its efficacy in extorting the truth, was that it proceeded by examination and oath of the parties, which parties who were in the wrong very much objected to, as it forced them to tell the truth; whereas at common law their opponents would be put to prove it, which they might be unable to do. In the course of time, however, the judicature of the Equity Court not being augmented as business increased, this became impossible, and the answers were taken in writing, though the evidence was still taken orally, before examiners. The judicial strength of chancery was by and by increased by the addition of masters, vice-chancellors, and lord-justices, but equity cases increased in far larger proportion, until at length suitors were necessarily kept waiting a long time before their turn for a hearing came.

Vexatious delay was not by any means the whole of the mischief caused by the concentration of all equity jurisdiction in one court. A suitor had rights in one court which were denied him in another, while it was an every-day matter for a judge to admit, in giving a decision, that he was not doing the justice to a case he could wish, and to observe that if a plaintiff or a defendant desired full justice he must bring another action or transfer the case to the Equity Court. The various courts had thus conflicting jurisdictions, without any power to assist each other or transfer a cause or a question from one to another—were in fact total strangers one to another, except that one could at times put an end to the proceedings of the other, and require them to be begun over again in its own forum. The abuses and delays were in fact such that the courts of justice might often have been aptly described as courts of injustice; for, after obtaining his strictly legal rights in a law court, a suitor could only obtain his equitable rights by recommencing his suit in an Equity Court, the case being thus indefinitely prolonged and the costs cruelly increased.

A royal commission appointed to inquire into the subject made a report in 1869 to the effect that the very numerous and grave defects which this system caused in the administration of justice could not be remedied by any mere transfer or blending of jurisdiction between the courts as then constituted, but only by consolidating *all* the superior courts into one High Court of Justice, in each and all the divisions of which there should be vested full jurisdiction both in equity and law. An Act to this effect was passed in 1873, but did not come into operation until supplemented by another Act passed in 1875. The more general changes effected by the JUDICATURE ACT will be found under that heading, but the most important title of the Act to public interest was the fact that it effected that long-desired fusion of the two systems of law and equity which had been for centuries inconveniently distinct and in some respects hostile. We need only notice here those provisions of the Act which made such very important, and, as the event soon proved, beneficial changes in the administration of equity.

The first of those provisions is in section 24 of that portion of the Act passed in 1873. This directs that law and equity shall be administered concurrently, and provides that a plaintiff claiming an equitable estate or right of which equity alone can take cognizance shall be entitled to ask from *any* division of the High Court the same measure of relief which he could previously have obtained in chancery alone. Thus, a ward can now vindicate his paramount and equitable title against the technical and legal rights of his trustee; a surety can sue his co-sureties for contribution to the loss sustained through their principal's default, and will no longer find that his remedy differs in different courts. Again, if a person, through his own mistake or another's fraud, entered into a contract he never meant to make, or undertook obligations he never meant to assume, he could only have the contract altered or re-formed by filing a bill in chancery. He can now assert his right in any appropriate branch of the High Court. With equal freedom plaintiffs may sue for contribution as co-sureties, may get contracts remodelled and fraudulently imposed obligations redressed, because "the courts and *every* judge thereof may give to the plaintiff such and the same relief as ought to have been given by the Court of Chancery before the passing of the Act."

We have already shown how a plaintiff and defendant, in order to obtain justice, often had, under the old system, to bring action after action against each other in order that one general case might be settled. The Act dispensed with all the refinements as to definite issues, &c., which rendered this necessary, and parties may now, in any court, obtain in a single suit all the benefits which previously might have required several different proceedings. The Act, indeed, gives every division of the High Court the most ample equitable jurisdiction over every subject of legal disputation, for the section (24) to which we have referred is very comprehensive; by it the courts are to recognize claims, demands, estates, and obligations created by common law, statute, or *custom;* and the High Court has to grant absolutely or conditionally all such remedies as any of the parties may be entitled to in respect of every legal or equitable claim that can be properly brought forward by them in any cause or matter. The Act contains provisions for enforcing the rules of equity in numerous special cases, previously governed by common law. Sub-section 10 of section 25, for instance, lays down that the rules of equity as to the custody of infants are to supplant those of common law, thus curtailing the father's all but absolute legal right to retain his children under his control. And (sub-section 11) *in all cases not specially provided for* equity is not now, as formerly, to follow the law; it is to govern it and to override it, for when there is any conflict or variance between the one and the other "the rules of equity shall prevail."

It must not be supposed, however, that equity can be administered solely at the discretion of the judge, according to the circumstances of each case. The effect of equity is to enable justice to be done between parties when there is no legal obstacle. If the doing of justice will controvert an established law, then equity has no power. If, for instance, through ignorance of its necessity a man omits to make a new will after marriage, it is quite conceivable that the effect may be very hard upon an individual, but equity cannot interfere to prevent the hardship. The matter is settled by the fact in law that marriage has rendered the old will null and void. Neither can equity interfere with the way a man disposes of his property by will, unless on the ground of clearly proven mental or legal defect. But in all the various divisions of the High Court, where there is no legal bar to equity then equity prevails.

In Scotland law and equity are both administered by the same judges. The Court of Session, however, possesses a superior power, termed *nobile officium*, whereby they exercise a purely equitable jurisdiction, under which they appoint guardians to minors and others incapable of acting for themselves, and other similar acts which in England used to be peculiar to the Courts of Chancery.

EQUIV'ALENTS OF HEAT, a most useful method of computing mechanical force, invented by Joule. He accurately measured the rise in temperature of a body of water caused by the friction of revolving of paddles within it, the paddles being driven by a falling weight. He found. after eliminating every disturbing element, that 1 lb. of water was raised 1° Fahr. by 772 lbs. weight falling one foot (772 foot-pounds), or 1° C. by 1390 foot-pounds. Joule's equivalent is therefore 772 for Fahrenheit, or 1390 for centigrade. In kilogrammes instead of pounds it is 424 for centigrade. Of course the opposite holds good; the raising of water a pound-degree Fahr. will store up energy equal to 772 foot-pounds. The unit of heat in the C.G.S. (centimetre-gramme-second) system of universal measurement — that is, the heat required to warm a gramme of water 1° centigrade—has for its equivalent 42,000,000 ergs.

E'RA, a series of years calculated from an EPOCH. [See also CHRONOLOGY.] The term, originally *æra*, comes from the Latin *æra*, money, *i.e.* coins used as counters for computation.

ERAS'MUS was born 28th October, 1467, at Rotterdam, where there is a bronze statue of him, erected in 1622. He was the illegitimate son of a citizen of Gouda, named Gerrit (Gerard), which, according to a pedantic fashion of the day, he translated doubly into Desiderius Erasmus. During his father's lifetime he was carefully educated; but at the age of fourteen he fell into the hands of dishonest guardians, who wasted his patrimony, and to conceal their peculations drove him, very unwillingly, into a monastery. He took the vows at Stein in 1486. Fortunately his skill in Latin caused him to be employed as private secretary to the Bishop of Cambrai, who in 1496 authorized him to proceed to Paris to continue his studies. At Paris Erasmus barely supported himself, in sickness and poverty, by taking pupils. For many years he led a wandering life, relying on the bounty of those patrons who were attracted by his learning and sprightly wit, sometimes in France, sometimes in the Netherlands, and sometimes in England, to which he was a frequent visitor. In England he became intimate with More, Colet, dean of St. Paul's, and other learned men, of whom he has spoken in high terms. For several years he applied himself diligently to the study of Greek. He was self-taught, he says; and one of his favourite employments was the translation of short Greek treatises into Latin, which answered the double purpose of improving himself and furnishing him with a number of books to dedicate to his wealthy friends. Careless, however, of economy, and not averse to pleasure, Erasmus was continually in want; and in one of his letters (xii. 21) he duns Colet for fifteen angels, promised for the dedication of his treatise "De Copia Verborum."

In 1506 Erasmus paid his first visit to Italy, during which he obtained from Pope Julius II. a dispensation from his monastic vows. At Bologna, Venice, and Padua, he improved his knowledge of Greek under the instruction of the best Greek and Italian scholars. He returned to England in 1510, and resided for some time at Cambridge, where he was appointed Lady Margaret professor (in divinity) and also lectured on Greek; his lodging was in Queen's College, in the grounds of which Erasmus' Walk is still shown. But in 1514, on an invitation from the archduke, afterwards Charles V., he went to Brabant, with the office of counsellor and a salary of 200 florins. After this we find him resident sometimes in the Netherlands and sometimes at Basel, where the great work in which he had been many years engaged, the first edition of the New Testament in Greek, was published in 1516, accompanied by a new Latin translation.

At the dawn of the Reformation, Erasmus, who in his witty writings had exposed many abuses of the Roman Catholic Church, especially those connected with the monastic system, was much embarrassed. It is clear that at heart he went a long way with the reformers, but he was of a timid temper, disinclined to sacrifice either life or comfort to his opinions.

He removed to Basel in 1521, where, in 1522, his "Colloquies" were published. In these Colloquies, which are generally very amusing, Erasmus has made some of his smartest attacks on various superstitions of the Roman Catholic Church. In 1529 he removed to Freiburg, when the reformed party acquired the ascendency in Basel, for to the last he never threw off an external adherence at least to the ancient faith. But in 1535 he returned to his former place of abode, endeared as it was by the presence of his most valued friends, in hope of renovating his declining health. About this time he received testimonies of high respect from Pope Paul III., who gave him a benefice. He died at Basel, 12th July, 1536, leaving an enduring reputation as the first wit of his age, the man of most general learning, and the most active and serviceable instrument in bringing about the revival of sound learning. Nor were his contributions small towards the success of the Reformation; he was an able sapper, though he wanted energy to storm the breach with Luther and his associates.

The Latin style of Erasmus is clear and elegant, like that of one who spoke and wrote Latin as readily as his mother tongue. His letters, comprising those of many learned men to himself, form a most valuable and amusing collection.

ERAS'TIANISM. See the following article.

ERAS'TUS, THOMAS, a physician, and the author of various medical works, but better known for the use made of his name in ecclesiastical discussions. His family name was Lieber, which he Græcized into Erastus. He was born at Baden in Switzerland, 1524, and studied in Basel in 1540. He afterwards went to Bologna, where he studied medicine. After having remained nine years in Italy he went to Germany, and was by the Elector Palatine, Frederic III., made professor of physic in the University of Heidelberg. He was appointed physician to the prince, and held rank as councillor of state in the palatine. He soon afterwards entered into polemical controversy on the question of the real presence, &c., and eventually became involved in a controversy on excommunication. The thesis called "Explicatio Quæstionis gravissimæ de Excommunicatione," which seems to have been written in 1568, was published in 1589, six years after the death of its author. The general principle adopted by Erastus is, that ecclesiastical censures, excommunications, and other inflictions are not the proper method of punishing crimes, but that the administration of all law should rest with the temporal magistrate. He held that the proper ground on which a person could be prohibited from receiving the ordinances of a church—such as the sacrament or communion of the Lord's Supper—was not vice or immorality, which concerned the civil magistrate alone, but a difference in theological opinion with the church from which he sought the privilege. The church was to decide who were its members, and thereby entitled to partake in its privileges, but was not entitled to punish offences by withholding these privileges, or by inflicting any other punishments on the ground of moral misconduct.

E'RATO, in the Greek mythology, was the Muse of Love and Marriage Songs. She is always represented crowned with a wreath and playing on a many-stringed lyre.

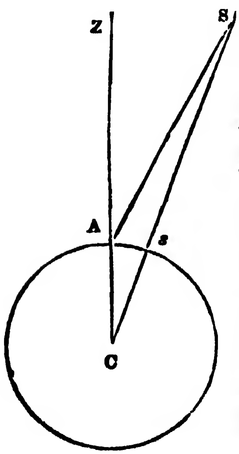
ERATOS'THENES, a distinguished contemporary of Archimedes, is stated to have been born at Cyrene in the year 276 B.C. He possessed a variety of talents seldom united in the same individual, but not all in the same eminent degree; his mathematical, astronomical, and geographical labours are those which have rescued his name from oblivion. Eratosthenes had not only the advantages arising from possessing the instruments and observations of

his predecessors, but the great Alexandrian library was intrusted to his superintendence by Ptolemy Euergetes.

The only work attributed to Eratosthenes which has come down to us entire, is entitled "Catasterismi," and is a catalogue of the names of forty-four constellations, and the situations in each constellation of the principal stars, of which he enumerates nearly 500, but without one reference to astronomical measurement. We find the astronomer Hipparchus quoted in it, and mention is made of the motion of the pole. These circumstances, taken in conjunction with the vagueness of the descriptions, render its genuineness extremely doubtful; at all events it is a work of little value. It is included in the Oxford edition of Aratus.

We find him engaged in astronomical researches far more exact and more worthy of his genius. By his observations he determined that the distance between the tropics, that is, twice the obliquity of the ecliptic, was $\frac{11}{83}$ of an entire circumference, or 47° 42′ 39″, which makes the obliquity to be 23° 51′ 19·5″, nearly the same as that supposed by Hipparchus and Ptolemy. As the means of observation were at that time very imperfect, the instruments divided into intervals of 10′, and corrections for the greater refraction at the winter solstice, for the diameter of the solar disc, &c., then unknown, we must regard this conclusion as highly creditable to Eratosthenes.

His next achievement was to measure the circumference of the earth. He knew that at Syene (now Assouan) the sun was vertical at noon in the summer solstice; while at Alexandria, at the same moment, it was below the zenith by the fiftieth part of a circumference; the two places are nearly on the same meridian (error 2°). Neglecting the solar parallax, he concluded that the distance from Alexandria to Syene is the fiftieth part of the circumference of the earth; this distance he estimated at 5000 stadia, which gives 250,000 stadia for the circumference: the annexed diagram will explain the principle of this admeasurement.



C the centre of the earth, A Alexandria, *s* Syene, S the sun, angle ZA*s* the $\frac{1}{50}$ of four right angles, angle A S C the sun's parallax, which though considerable in the diagram for the sake of clearness, is in reality very small. The angle AC*s* very nearly = ZA*s*; therefore the distance A*s*C = $\frac{1}{50}$ of the circumference of the earth.

Thus Eratosthenes has the merit of pointing out a method for finding the circumference of the earth. But his data were not sufficiently exact, nor had he the means of measuring the distance A*s* with sufficient precision.

Eratosthenes has been called a poet, and Scaliger, in his commentary on Manilius, gives some fragments of a poem attributed to him, entitled "Hermes" or "De Zonis," one of which is a description of the terrestrial zones: it is not improbable that these are authentic. That Eratosthenes was an excellent geometer we cannot doubt, from his still extant solution of the problem of two mean proportionals, preserved by Theon.

Eratosthenes appears to have been one of the first who attempted to form a system of geography. His work on this subject, entitled "Geographica," was divided into three books. The first book contained a history of geography, a critical notice of the authorities used by him, and the elements of physical geography. The second book treated of mathematical geography, and contained the method above explained, by which he determined the earth's circumference. The third book contained the political or historical geography, arranged according to the three great divisions of the known globe, Europe, Asia, and Libya. The whole work was accompanied with a map of the known world. The geography of Eratosthenes is lost; the fragments which remain have been chiefly preserved by Strabo, who was doubtless much indebted to him.

Eratosthenes arrived at the age of eighty years, and ultimately, becoming blind and weary of life, is said to have died by voluntary starvation. The best collection of his fragments is by Bernhardy (Berlin, 1822).

ER'BIUM, a metal discovered by Mosander in 1843. It is found in gadolinite associated with yttria and terbia. It has not been isolated in a pure state. Bunsen gives 112·6 as the atomic weight. The oxide erbia, an alkaline earth, is always contaminated with yttria, from which it has not been perfectly separated. It has a deep yellow colour, and is a weak base. The salts are colourless, the sulphate having a sweetish taste.

ERECHTHE'IUM, a beautiful Ionic temple dedicated to Erechtheus, built near the western brow of the Acropolis at Athens. Connected with this building, and placed on one side of it at the end of the cella, is a tetrastyle pseudo-dipteral Ionic portico, in the same style as the portico of the Erechtheium, forming a small temple, which was dedicated to Athena Polias; and on the opposite side is a small roofed building supported by caryatides placed on an elevated basement, forming another small temple dedicated to Pandrosos, and called the Pandrosium. The back wall of the cella of the temple of Erechtheus is decorated with four semi-columns *in antis*, engaged in the wall, and of the same order as the portico, which is hexastyle and raised on three steps, forming a basement which runs round the entire building with its adjuncts. The side portico, called Athena Polias, was most probably constructed after the Erechtheium. The Erechtheium and Pandrosium will be found in our Plates on GREEK ARCHITECTURE.

ERECH'THEUS or **ERICHTHO'NIUS**, first king of Athens, was the child of Hephæstus (the Latin Vulcan) and Atthis, or according to some accounts Gæa. Hephæstus had sought the love of the virgin-goddess Athena, and although she had denied his suit she was kind to his son, and reared him carefully. Turning him when a boy to the form of a serpent, her sacred animal, she intrusted him in a closed box to the care of certain nymphs, whose curiosity getting the better of their prudence they opened the box, and were so horrified at the serpent within that they threw themselves from the Acropolis. Athena preserved the child, and when he had grown up he expelled Amphictyon, son of Deucalion, who then ruled Attica, and founded the temple of Athena on the Acropolis. He invented the quadriga and instituted the Panathenaic games. He was worshipped as a divinity, and his famous temple, the ERECHTHEIUM, is still one of the glories of Athens. His grandson Erechtheus was also King of Athens.

EREMACAU'SIS, or **DECAY**, is a process of slow combustion in the presence of air and water. This process is constantly going on in combustible organic bodies exposed to the atmosphere, and one of the first changes which takes place during the decomposition of animal and vegetable substances is the union of one or more of their elements with oxygen. The carbon and hydrogen are usually converted into carbonic acid and water. The changes in colour, consistence, and other properties which vegetable juices, sawdust, leaves of trees, blood, &c., undergo when exposed to the atmosphere are owing to the same cause. Eremecausis differs from fermentation and putrefaction in the fact that it cannot take place without the access of atmospheric air, through which means the

oxygen is supplied to the decaying body. Eremecausis must precede any decomposition of an organized substance; and it is by virtue of this law that animal or vegetable food may be kept from putrefaction by being heated to the temperature of boiling water, and then secured in air tight vessels. Food thus prepared may be kept for many years as fresh as when first secured. This has led to a large industry in the preparation of tinned animal and vegetable foods. In eremecausis of wood the residuum is named *ulmin*. The term was first used by Liebig.

ER'FURT, a government of Prussian Saxony, is bounded N. by Hanover and Brunswick, E. by Merseburg and Saxe-Weimar, S. by Saxe-Coburg-Gotha, Saxe-Meiningen, and Saxe-Weimar, and W. by Hesse. Its length from N.W. to S.E. is 60 miles; its breadth varies from 8 to 38 miles. Its area is 1363 square miles, and its population in 1880 amounted to 380,000, rather more than one-third of whom are Roman Catholics and the remainder Evangelical Protestants. The soil of this province is favourable for the cultivation of grain, and rather more than half of its surface is arable land. About one-fifth of it is appropriated to meadows or pastures, and rather more than one-fourth is occupied by woods and forests. The principal rivers are the Erlau, the Saale, and the Wipper. The chief products are grain, flax, tobacco, hops, oil, and salt. Great numbers of horses, horned cattle, sheep, goats, and swine are reared. In the circles of Weissensee and Schleusingen there are mines of iron, lead, and copper. Marble and gypsum, as well as sulphur, are also among its mineral productions. Erfurt is likewise distinguished for its manufactures of iron and steel ware, tin plates, seed-oil, woollen yarns, cloths, flannels, carpets, linens, silks, cottons, stockings, paper, porcelain, glass, brandy, wooden clocks, &c.

ERFURT, the capital of the above government, is situated on the Gera, a tributary of the Unstrut, in a richly cultivated plain, 14 miles by railway W. from Weimar, and has 53,254 inhabitants. It was formerly the capital of Thuringia, and was a fortress of the second order, possessing two citadels—one, Petersburg, within the walls, and the other Cyriaxburg, on Mount Cyriax, outside of the town—but the works are now being removed. Erfurt has six gates, five public squares, one of which, the market square, is ornamented with an obelisk of stone 50 feet high, erected in 1802 to Charles, elector of Mainz, several broad and well-built streets, and numerous Roman Catholic and Protestant churches. The cathedral church of St. Mary is a fine Gothic structure of the thirteenth century. In this church there is a bell called the Maria Clara Susanna, cast in 1492, which weighs about 13 tons. The cell of the former Augustine monastery, in which Luther resided from 1501 to 1508, was shown until all reminiscences of the illustrious reformer were destroyed by a fire in March, 1872. Of the numerous religious houses which Erfurt formerly possessed the Ursuline convent alone remains, and has a female school attached to it, which is superintended by the nuns. Among the scholastic institutions in the town are—a high school, a gymnasium, a deaf and dumb school, and schools of surgery, design, and architecture. Among other institutions there are—a botanical garden; a library of about 50,000 volumes, formerly belonging to the university, which was suppressed in 1816; an ophthalmic hospital, and a general hospital. Erfurt is the seat of provincial administration and of the provincial tribunals. It has considerable manufactures of cottons and woollens, besides less extensive ones of linens, ribbons, leather, soap, earthenware, meal, seed-oil, stockings, gloves, tobacco, &c., and it carries on a brisk trade in fruits, seeds, groceries, drugs, grain, &c.

Erfurt first formed part of the Prussian kingdom in 1803; from 1807 to 1813 it was occupied by the French, and in 1808 a memorable interview took place in it between Napoleon and Alexander, emperor of Russia. It was restored to Prussia in 1814.

ERG is the name for the unit of electrical work or energy. One *erg* is the amount of energy produced in overcoming one unit of electrical force through one unit of distance—*i.e.* in pushing a body through a distance of one centimetre against the force of one DYNE. (It takes 981 ergs to raise one gramme against gravity to the height of a centimetre.)

ER'GOT, a name bestowed upon a diseased state of the seed of several grasses, but most frequently of the rye, which resembles a spur or horn. The spur is of variable length, from a few lines to 2 inches, and is from 2 to 4 lines in thickness. When large only a few grains in each ear are affected; when small, in general all of them are diseased. In colour the exterior or husk is of a bluish-black or violet hue, with two or three streaks of dotted gray; the interior is of a dull whitish or gray tint. It is specifically lighter than water, which affords a criterion for distinguishing sound from tainted grain. When fresh it is tough and flexible, but brittle and easily pulverized when dry. The powder is apt to attract moisture, which impairs its properties, and time destroys them.

Spurred rye occurs more frequently in some countries and districts than in others, and more abundantly in some seasons than in others. Rye raised in poor soil, and in a humid close air, such as that of the district of Sologne in France, is most liable to be infected; but, according to the experiments of Wildenow, it may be brought on at any time by sowing the rye in a rich damp soil, and watering the plants freely in warm weather. A very rainy season is apt to produce it.

Bread prepared from grain which has a large admixture of the spur occasions very distressing and often fatal effects, which are shown more or less rapidly according to the quantity present in the food and the circumstances in which those who use it are placed. The symptoms which result from spurred grain, when used for a considerable time, are of two distinct kinds—one of a nervous nature characterized by violent spasmodic convulsions, the other a disordered state of the constitution, which terminates in the peculiar disease called *gangrœna ustilaginea*, or dry gangrene. In the case of parturient females, when given at a certain stage of the labour, it is admitted by most practitioners and writers to produce specific effects, and to expedite the labour in a very marked manner. It is by some persons alleged to produce hurtful effects upon the child; but such consequences probably occur only when it has been used at an improper stage of the labour, or when it ought not to have been employed at all.

Ergot is produced by a fungus (*Claviceps purpurea*) belonging to the ASCOMYCETES. It begins as a sticky thready substance (*mycelium*) between the pales at the base of the ovary. It gradually spreads through the tissues until it has destroyed them. At this stage it is called *sphacelia*. The fructification consists of minute spores at the end of long cells (*basidia*), which cover the ridges. At the base of the sphacelia the mycelium is thick and firm; this part increases, and pushing the sphacelia upwards, forms the ergot or *sclerotium*. This has a distinct kind of fructification, consisting of the spurs pushed out from the surface of the ergot. The surface of the heads is rough with prominences, in the centre of each of which is a tiny hole leading to a cavity containing long and slender bag-like structures (*asci*) containing spores. The fungus is propagated by both kinds of spores. The mature ergots fall from the plant about July, remain dormant till the following spring, when the spurs are produced, and the spores ripen in time to produce the disease as the grass is coming into flower.

ER'GOTINE, the active principle of ergot of rye. It is a reddish-brown powder of an acrid bitter taste and heavy

odour, and is insoluble in water and ether, but soluble in alcohol. It is used in medicine for producing uterine contraction.

ERI'CA. See HEATH.

ERICA'CEÆ, an order of GAMOPETALÆ, which derives its name from the extensive genus Erica (heath). It is readily known from other gamopetalous orders by the hypogynous corolla and stamens, the anthers opening by pores, the superior ovary with more cells than two, and the seeds albuminous. The Vacciniaceæ and Monotropeæ have been included by some botanists, but in the latest work of authority—Bentham and Hooker's "Genera Plantarum"—they are treated as separate orders. Besides the genus Erica, the order contains the Arbutus or Strawberry Tree, Andromeda, Rhododendron, including Azalea. The fruits of some are edible, but the greater number are narcotic and even poisonous, while the foliage too of some genera is dangerous.

It is unknown in very hot countries, except at considerable elevations; it appears generally to love exposed situations, and, with the exception of Erica itself, to follow mountain chains, as it advances from the cool plains of the temperate zone to the equinoctial regions. See HEATH.

ERICHTHO'NIUS, a second name of the elder ERECHTHEUS, first king of Athens.

ERID'ANUS (the river Eridanus), a constellation first mentioned by Aratus. In the heavens it is a winding stream, not very well marked by stars, extending from a bright star (α) of the first magnitude, called Achernes, situated near the southern part of Phœnix, and ending at the star Rigel in Orion. It will be found in our Plate CONSTELLATIONS, Southern Hemisphere, winding from near the figure IV. to the pole.

E'RIE, a city and port of entry of the United States, in Pennsylvania, and the chief town of a county of the same name, situated 88 miles W. of Buffalo on Lake Erie. Erie is a centre of trade of increasing importance. Abundance of water-power is obtained from the lake by pumping water to the height of 200 feet, and thence distributing it to the various mills and manufactories. It is connected by railway with all parts of the States, and the harbour, which is formed by Presque Isle and a breakwater 3½ miles long and 1 mile broad, is one of the best on the coast, having from 9 to 25 feet of water. The town is well built, and has the usual institutions and government offices of a modern city. The manufacture of iron goods, rolling mills, tanneries, and breweries give employment to the inhabitants. It was here that the fleet was equipped that defeated the British on Lake Erie in 1813. Population, 27,737.

E'RIE, LAKE, is the southernmost and fourth in the chain of lakes connecting with the St. Lawrence. On the west is the Canadian province of Quebec, and on the other sides the states of New York, Pennsylvania, Ohio, and Michigan. It is 265 miles long by 80 broad, and is of an elliptical form. Area, 9600 square miles. Height above the sea, 565 feet; above Lake Ontario, 322 feet. It is 16 feet below Lake Huron, and receives the waters of Lakes Superior, Michigan, and Huron by the river St. Clair, discharging to Lake Ontario by the river Niagara. The greatest depth ascertained is 270 feet, being much less than that of the other great lakes, and in most parts the depth does not exceed 120 feet. This is particularly the case towards the western extremity, where there are many small islands, few of which are inhabited, but which are greatly infested with rattlesnakes. Its waters are clear and pure. The navigation is dangerous, owing to the sudden and severe storms and the heavy ground-swell; but there is, notwithstanding, an extensive and increasing traffic carried on both by steamers and sailing vessels. Lake Erie communicates by canals with the Ohio and the rivers of the east coast. The chief ports on its shores are, in the United States, Buffalo, Erie, Cleveland, and Sandusky; in Canada, Sherbrooke, Santicoke, and Port Burwell.

ERI'GENA, JOANNES SCOTUS, a native of Ireland, from whence his appellation of Erigena is derived, that of Scotus being synonymous with it (the Irish being the original Scots), flourished about the middle of the ninth century. He resided chiefly in France, at the court of Charles the Bald. His writings on theological matters were considered as heterodox, and his treatise on the eucharist was condemned to be burnt by the council of Rome, 1059. In his work "Dialogus de Divisione Naturæ," he displays a wonderful information for the times he lived in, and an intimate acquaintance with the Greek language. He gives large extracts from the Greek fathers, and also quotes Aristotle, Plato, Cicero, Pliny, and other ancient writers, and he gives the opinions of Pythagoras and Eratosthenes on some astronomical topics. His best known work is his translation of Dionysius Areopagitica. Erigena is supposed to have died in France about the year 875. He must not be confounded with DUNS SCOTUS.

ERI'GERON, a genus of plants belonging to the order COMPOSITÆ, tribe Asteroideæ. *Erigeron philadelphicum* is a native of North America, and is used as a medicine in the United States. It possesses stimulant properties, and is given as an emmenagogue; it also acts on the kidneys, and is considered a valuable diuretic. It has a powerful fetid smell. *Erigeron acris* contains about 5 per cent. of potash, and it is sometimes burned for procuring the alkali. It has a strong scent, and like many other species of the family is said to keep away fleas. With species of Conyza and Pulicaria, it has the name of flea-bane. It is a native of Europe, and is a common plant in Great Britain. *Erigeron canadensis* is also found in England and Scotland; it is a rare plant, and is found on waste ground, and it is tonic as well as diuretic. *Erigeron alpinus* is a native of the Highland mountains. The species are about 100 in number, and some of them are ornamental plants. The name of the genus is Greek, and means soon becoming old, from the hoary down of the flower-heads.

ERIN'YES. See EUMENIDES.

ERIOCAU'LEÆ, a group of plants for the most part inhabiting swampy or marshy places, or the bottom of lakes, and having the flowers collected in dense heads. The flowers are always very small, and difficult to examine on account of the thinness and delicacy of their texture. Eriocaulon itself is the principal genus, consisting of about 100 species, most of which are met with in the equinoctial parts of America, and one solitary instance, *Eriocaulon septangulare*, in Skye and neighbouring islands, and also in Connemara. In South America, although they prefer marshy and inundated places, yet some are found upon damp sand, others among grass, and some in dry and stony places; they are also frequently met with in alpine situations, some as high as upwards of 5500 feet above the level of the sea on the summit of Mount Itambé.

Eriocauleæ belong to the Glumaceæ among MONOCOTYLEDONS. The flowers are unisexual, with six or fewer divisions in the perianth; the ovary has two or three cells, with pendulous orthotropous ovules; the seed is albuminous, with a small embryo. There are six genera. The species are natives of East Asia, Australia, South Africa, South America, and the eastern states of North America; one American species, as stated above, is also found in Scotland and Ireland.

ERIODEN'DRON is a genus of plants belonging to the BOMBACEÆ. It differs from the genus Bombax in the staminal coloumn having five branches, each branch with two or three anthers. The flowers are large, of a white or pink colour. The leaves are shaped like those of the horse-chestnut. There are eight species, natives of the tropics, one found in Asia or Africa, the rest in America.

ER'IS, the Greek goddess of discord, sister of Ares, god of battles, according to Homer. Her anger at not being invited to the wedding feast of Peleus and Thetis, and her revenge at the neglect, which she carried out by throwing the famous "apple of discord" among the goddesses "for the most beautiful," are given as the causes of the war of TROY.

ERIS'MATURINÆ is one of the subfamilies into which the great family Anatidæ [see DUCKS] is divided. The Erismaturinæ are the spiny-tailed ducks, distinguished by the extreme rigidity of the tail-feathers, which are narrow and pointed, and are not covered at the base by the upper tail-coverts. The group is a very small one. The White-headed Duck (*Erismatura leucocephala*) occurs in Siberia, Russia, the south-east of Europe, and North Africa. It principally haunts fresh-water lakes, diving and swimming with great ease, but it is averse to rising into the air. Another genus, Biziura, contains a remarkable Australian species, *Biziura lobata*, the male of which has a large lobe of skin hanging down under the chin. The male considerably exceeds the female in size.

E'RITH, a parish of England, in the county of Kent, 14 miles from London by the South-eastern Railway, situated on the right bank of the Thames. It has 9812 inhabitants. In the neighbourhood are extensive powder mills, which were the scene of a terrible explosion in 1864, the report being distinctly heard in, and causing considerable alarm throughout, London. There are some extensive lime and sand pits here, from whence ballast is shipped; and the brickfields in the vicinity are among the largest in the kingdom. In one of the sand-pits elephants' tusks have been found. It has Wesleyan and Congregational chapels, national schools, and a fine old church, where Hubert de Burgh met the barons to settle the terms of peace after the signing of Magna Carta. Erith has very much increased of late years, and numerous villas have sprung up in the pleasant environs. Erith is the old Saxon *Aerre-hythe*, and here Henry VIII. built his great ship, the *Grace de Dieu*, in 1515.

ERIVAN' or **IRWAN',** a town in the Russian government of Georgia, situated about 40° N. lat., 44° 30′ E. lon. It has about 15,000 inhabitants. It is situated on the Zanga or Zenui, which flows from the Lake of Erivan and falls into the river Aras. The river is crossed at the town by a handsome stone bridge of several arches. The town is built partly on a hill and strongly fortified. The citadel is about 2000 yards in circuit, and encompassed by a double rampart of earth flanked with towers; it contains the ancient palace of the khans, now the residence of the governor; a fine mosque, a cannon foundry, and barracks. The grapes, peaches, and other fruits are most highly esteemed; the transit trade between Persia and Russia is important; and there are manufactories of cotton, leather, &c. The name is said to denote permanent settlement, an allusion to the descent of Noah after the deluge. The celebrated Armenian convent of Etschmiadzin, the residence of the Armenian patriarch, called Catholicos, and the great centre of Armenian literature, stands about three hours west from Erivan. The library of this convent is rich in Armenian manuscripts, some of which are said to be of considerable historical value. The base of Mount Ararat is only about 6 or 8 miles from the town. Erivan was formerly the capital of the Persian province of Aran. It was ceded by Persia to Russia by the treaty of Turkmanjai, February, 1828.

ER'LANGEN, a town of Bavaria, in the circle of Central Franconia, on the Regnitz, 28 miles south of Bamberg on the railway from Bamberg to Nürnberg. It is walled and divided into the old and new towns; the latter, which is one of the best-built towns of Germany, was founded by Christian Ernest, margrave of Bayreuth, in 1686. It contains the celebrated Protestant university, the only one in the kingdom, established 1743, and usually attended by about 400 students. This institution occupies the ancient palace of the margraves of Bayreuth, and has connected with it schools of theology, moral philosophy, midwifery, medicine, and the fine arts, a polytechnic school, a gymnasium, general and lying-in hospitals, cabinets of natural history, a botanic garden, and a library of 110,000 volumes. The palace gardens are very handsomely laid out, and adorned with statues. Woollen goods, stockings, hats, leather, and leathern articles are made in the town, which has also a large plate-glass manufactory and a brewery, besides some trade in cattle. Most of the population are Protestants, and it altogether numbers 14,876. Many French refugees settled in Erlangen after the revocation of the Edict of Nantes, and in 1666 the first learned society in Germany was established here.

ER'LAU (*Eger*), a town in the Hungarian circle of Hither Theiss, is situated in a beautiful valley in the midst of richly cultivated lands, and has about 20,000 inhabitants. The Erlaubach divides it into two parts, which are surrounded by fortifications about 7 miles in circuit, and entered by six gates. The town is the seat of an archbishop. It contains several Roman Catholic churches and monasteries, a Greek and a Protestant church. The houses in the town are large, and built in a neat style. The chief buildings are—the lyceum, in connection with which there is an observatory, a handsome chapel, and a very spacious examination-hall and library, the cathedral church, the church of the Minorites, and the archbishop's palace. The lyceum was formerly a university; it is attended by a great number of students. The town is important for its baths and its trade in red wines, the produce of the vineyards in the vicinity. The manufactures consist of linens, woollens, hats, &c. Near the archiepiscopal park are the bishop's and the Rascian baths, well fitted up, with warm springs, used as a remedy for cutaneous diseases. In 1535 Erlau sustained a memorable siege from the Turks, on which occasion the town owed its preservation to the heroic conduct of the women, but the Turks ultimately gained possession of it in 1596.

ER'MINE or **STOAT** (*Putorius ermineus*), one of the MUSTELIDÆ or weasel family, is larger than the common weasel, being about 10 inches long, exclusive of the tail; this organ is 4½ inches in length, slightly bushy towards the tip, the hairs of which are invariably black. In the summer the fur is reddish-brown on the back, and white underneath from the chin to the root of the tail. In winter the fur becomes white, with a tinge of pale yellow, the black tip of the tail remaining unchanged. In high northern regions the fur becomes of a pure white. In some parts of England the change is only partial, strips or patches of dark-coloured fur persisting in the winter. A similar change is seen in many animals who inhabit high latitudes. It is protective, assimilating the colour of the animal to the surrounding snow; a carnivorous animal like the stoat is by its white fur at once protected from its enemies and aided in its attacks on its prey. There takes place, according to Bell, an actual change of colour in the fur from brown to white, brought about mainly by the change in temperature. The ermine, like the weasel, has a long lithe body with exceedingly short limbs. In its habits, too, it resembles the weasel. It is very destructive to poultry and game. It destroys great numbers of rats, mice, and water-voles, and will even attack hares. It is remarkable for its boldness and pertinacity, taking to the water and climbing trees in pursuit of its prey.

The ermine is spread over Europe generally, but is common only in the north. The finest ermine skins, that is, those with the longest and thickest fur and of the purest and brightest colour, are imported from the high latitudes. Russia, Norway, Siberia, and Lapland furnish them abundantly. Every one is familiar with the pure

white, glossy texture of ermine tippets, boas, and other robes, whose snow-white groundwork is beset and adorned with a regularly-disposed series of quincuncially-arranged tails, forming a striking contrast by their rich jet-black colour. The ermine is usually caught by very simple means, namely, by a trap in the form of a heavy stone or slab, which, being delicately supported by a thin stick baited with flesh, at the first or second nibble suddenly falls and crushes the intruder.

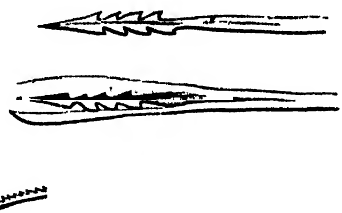
ERNE. There are two lakes and a river of this name in Ulster, Ireland. The lakes (Upper and Lower) are connected by a narrow winding channel or river, 8 miles long. Upper Lough Erne is 14 miles long and 2½ broad. Area, 9453 acres; greatest depth, about 70 feet, but in general not more than 20 feet. Its shores are beautiful and well wooded, and it has almost 100 picturesque islets. The lower lake is 20 miles long by 5 broad, and more than 225 feet deep; height above the sea, 150 feet; area, 27,645 acres. It has considerable hills on its south shore, and a vast number of beautiful islands, among which is the island of Devenish with its interesting ruins. The scenery of both lakes is very much admired. They are almost entirely in county Fermanagh. The river Erne rises in Lough Gonnagh in county Longford, flows north through Lough Oughter in county Cavan, passes through the two lakes, and flows west from thence to Donegal Bay, which it enters below Ballyshannon. At the latter town it forms a fine cataract, called the Salmon Leap, about 12 feet in height. Total length, about 30 miles; with the lakes, 80 miles. The basin of Lough Erne (area, 1585 square miles) has internal water communication with the basin of Lough Neagh and the Bann by the Ulster Canal and river Blackwater, and thence there are canals to Belfast and Newry.

ERNE. See SEA-EAGLE.

ER'OS, god of Love, usually the same as the Latin Cupid, son of Aphrodite (Venus), but, according to Hesiod, and in the eyes of the philosophers, one of the primeval gods who succeeded Chaos, and who, especially, formed heaven and earth by his power of inspiring union. In this sense Eros means rather the god of affinity than of the passion of love. But the Eros of the poets differed widely from this. Here Love is the youngest of the gods, born of Aphrodite after all the rest, never growing beyond boyhood; always tricky and mischievous, delighting to plague even his mother with his sharp gold tipped shafts, which inspired violent love, or with his blunt leaden darts, which aroused hate for the next person of the opposite sex whom the stricken one encountered. No longer the mystic spirit of union dominating all nature, he is little more than the winged god of swift, capricious sensual desire; often, too, blind or blindfolded, and thus setting hearts on fire at random with his ever-burning torch. Only one beautiful myth is attached to Eros, that of PSYCHE.

ERO'SION is a term employed in geology to denote the scooping out of the earth's surface by various agencies, *e.g.* by rivers, glaciers, or by the sea. A river in flowing over its bed carries along gravel, pebbles, &c., and these gradually grind down the bed, the products of this grinding action being a more or less finely divided sediment or mud, which the river ultimately carries down to the sea. What is known as a river-basin is simply the results of the erosive action of a river and its tributaries, which have gradually scooped out a valley or basin, sometimes of considerable depth. Glaciers erode the surface of the country over which they pass, by grinding it down with stones which they force along, either by friction or by holding them frozen into their places. Some geologists have attributed the formation of lake basins in rocky countries to the erosive action of glaciers; but it is doubtful whether they possess sufficient scooping action to hollow out such basins, their action being rather to grind down a surface evenly. *Potholes* are instances of local erosion by river eddies and glaciers. The sea erodes in several ways. Currents and ground-swell often erode the sea bottom in shallow water, or breach and partially remove mud and sand-banks. The force of breakers, sometimes amounting to 3 tons to the square foot, batters the rocks of a coast even high above the water-mark. Pieces of rock, detached by these means, often increase the extent of this erosive action by being dashed against the rock on the coast. Sea caves are evidence of marine erosion, so is the frequently occurring undermining of cliffs which are unprotected by a beach. Bays exhibit the results of this erosive action on a large scale. Scenery is entirely the result of the erosive action of water in some one or other form. Erosion is one of the processes included under the general term DENUDATION; it deals simply with the actual wearing or scooping out of rocks: the consideration of the removal of eroded matter comes under the general head.

ERRAN'TIA is an order of ANNELIDA, forming with the order TUBICOLÆ (or Sedentaria) a division, Polychæta, marine worms with well-developed locomotive organs. These locomotive organs (*parapodia*) are lateral outgrowths of the body-wall of each segment, and are either in one or two lobes. These lobes are provided with numerous bristles of various complicated shapes. In this



Bristles of Errantia.

order the body is more or less cylindrical, made up of a great number of segments, similar throughout the body except in the anterior region, where the several segments are fused together to form a distinct head. The head is furnished with a pair of rudimentary eyes, and with a number of conical or thread-like appendages, which are distinguished into antennæ, palps, and tentacles. The antennæ are long and thread-like, are placed before the mouth, and are not modified parapodia, as are the palps. The last segment of the body usually bears two elongated filaments. In some forms, some of the segments bear overlapping scales or elytra. The alimentary canal is simple. The pharynx is eversible, and has horny growths at its base, which play against one another when the pharynx is everted, and so act as jaws. For such an eversible pharynx, usually called by the ill-defined and misleading name "proboscis," Professor Ray Lankester has proposed the term *introvert.* This pharynx leads into a simple œsophagus. Respiration is carried on by means of external branchiæ arranged along the back for the whole or part of the length of the body. The branchiæ vary much in form, number, and position. In some the organ assumes the

form of arbuscles or tufts, or fan-shaped crests; in a second series it is a simple or pectinated filament; and in a third it is a nipple-like lobe, or merely a membranous tubercle. The branchiæ are often rudimentary or absent, and their function is then effected by the skin. The blood-vascular system is well developed. It consists of a dorsal and ventral trunk with communicating branches, and furnished in some forms with dilatations or "hearts" at the base of the branchiæ. The blood is usually red, but is sometimes colourless. In some of the Errantia the blood-vascular system is altogether absent. The body-cavity or cœlom is filled with a fluid containing colourless corpuscles. In Glycera and Capitella Ray Lankester has found red corpuscles deeply stained with hæmoglobin. The nervous system is simple, consisting of a pair of cerebral ganglia, the cords from which meet below the mouth and are continued thus united along the ventral surface of the body as a double gangliated cord with two ganglia to each segment; the nerve cords in some cases remain distinct. The excretory segmental organs (nephridia) are very minute or rudimentary.

The sexes are distinct. Reproduction is usually sexual. Many multiply also by transverse fission. In Nereis an alternation of *sexual* generation takes place. The eggs of Nereis produce a form known as Heteronereis, which is sexually complete and lays eggs which produce Nereis again. In this order the embryo is hatched as a free-swimming form with a spherical ciliated body; the cilia soon become restricted to a band round the middle of the body and a tuft at the top. The upper hemisphere becomes the head, the mouth is situated below the ciliated band. The lower hemisphere rapidly elongates and develops segments and parapodia. The ciliated band finally withers up. New segments are continually formed between the penultimate and last segment.

All the species belonging to this order are aquatic, crawling with activity in the mud or swimming with facility in the water. Some of them are truly pelagian, and are only met with in the high seas; but the great majority dwell between tide-marks on the shore, where they find refuge and concealment under stones or among corallines and seaweeds. A small number burrow in the sand, in which they form a sort of sheath by a glairy secretion from the skin, and a few inhabit tubes; but these sheaths are not indispensable, and can be occasionally abandoned without inconvenience. Their habits are predaceous. They have a wide distribution, being found in the seas of most parts of the globe. Some species are phosphorescent, and most are extremely beautiful objects from their brilliant and varied hues, yielding in beauty neither to the plumage of humming birds nor the most brilliant precious stones. The species are very numerous. Among the most important and interesting families are Aphroditidæ (SEA-MOUSE), EUNICIDÆ, NEREIDÆ.

ERRAT'IC BLOCKS are masses of rock differing in character from any rock in the immediate vicinity of the place in which they are found. Thus boulders of granite are found in Yorkshire and Staffordshire, blocks of gneiss and granite are scattered all through the Swiss valleys, and occur high up on the flanks of the Jura, the latter mountains being for the most part limestone. These blocks are sometimes of large size, a famous one near Neufchatel, called the Pierre à Bot, is 40 feet high, 50 feet long, and 20 feet wide, and is estimated to weigh 3000 tons. Enormous blocks of gneiss and granite, called the "blocks of Monthey," are found on the left bank of the Rhone, near Lake Geneva, and similar blocks are found in abundance on the southern side of Lake Como. The Staffordshire and Yorkshire blocks are found to be identical in lithological character with the Shap granite of Westmorland, while the Swiss, Jura, and Piedmont blocks are evidently derived from the Alps. For a long time these blocks formed one of the greatest puzzles of geology, but their presence is now completely accounted for. They were undoubtedly conveyed by ice, some carried by glaciers, and left on the melting of the ice constituting the glacier; others have been carried out by icebergs and dropped on submerged land which has again been elevated. There is the strongest possible independent evidence of a period when the whole of the north of Europe and America was in much the same condition that Greenland is now. [See GLACIER.] Huge glaciers came down from the Scotch and Cumbrian highlands, from the Scandinavian mountains, and from the Alps, and overspread enormous tracts of country. The Alpine glaciers evidently filled up the huge valley between the Alps and the Jura to such a height that they were able to leave moraines (detached blocks) over 1000 feet up the sides of the latter mountains. These blocks are found not only on the surface, but imbedded in the so-called "boulder clay" [see DRIFT], the boulders and blocks of which are fragments of rock from the Scandinavian highlands as far south as Holland. Erratic blocks are found at various periods throughout geological history. Blocks of granite and gneiss are found in clay slate of Lower Silurian age in Scotland. The Eocene rocks of the Alps contain erratic blocks of enormous size, probably derived from the mountains of Bohemia. Isolated blocks are not necessarily erratics, even though they rest on rock of a different nature. They are frequently outliers of a stratum, the rest of which has been removed by denudation, and the main mass of the rock may be a considerable distance off. The so-called "grey wethers" of the southern counties are the remains of a stratum of chalk once covering the district in which they occur, but now removed by denudation. The large stones of Stonehenge are blocks of this nature, shaped and arranged by a prehistoric race, but not, as formerly imagined, conveyed by them from a great distance.

ER'RHINES, medicines which are applied to the nostrils, and which cause an increased flow of the secretion of the membrane which lines them, and often of the contiguous cavities and sinuses, frequently also occasioning sneezing and an unusual secretion of tears. Snuffs of different kinds are familiar examples of this class of substances, and these generally cause sneezing, at least when first employed; but others, such as the mineral turpeth, merely produce increased secretion of the membrane. Where sneezing ensues a considerable shock is felt over the whole frame, and of this effect advantage is sometimes taken to change the action of the system, or to remove morbid impressions, as when certain fits are impending, or for more limited purposes, such as dislodging any foreign body from the nose. The secondary effect of errhines is more frequently desired to give relief to the loaded vessels by exciting them to increased secretion. As a means of obtaining relief from the effects of a cold in the head Dr. Ferrier recommends the use of a snuff composed of hydrochlorate of morphia, 2 grains, subnitrate of bismuth, 6 drachms, and gum-acacia in powder, 2 drachms. Of this quantity from a quarter to a half may be taken in the course of twenty-four hours. It should be taken at the outset of the cold, and should be used frequently at first so as to keep the nostrils well coated with the powder.

ERROR, in law, a fault in the pleadings, or in the process, or in the judgment. It was formerly the ordinary mode of appeal from a court of record, and was in the nature of a commission to the judges of a court superior to that in which the judgment was given, by which they were authorized to examine the record, and on such examination to affirm or reverse the judgment according to law. Bills of exceptions and proceedings in error in civil cases are now abolished, and all appeals to the Court of Appeal must be by way of rehearing brought on by notice of motion in a summary way. In criminal cases a writ of

error may be issued, but not without a fiat of the attorney-general.

ERSE, the native language of Ireland, is one form of Gaelic. The Celtic tongues are divided into Cymric and Gaelic, whereof the first is Welsh, old Cornish, and old Breton, and the second divides into Highland Gaelic, Erse, and Manx. The earliest English writing adopted the Irish and not the Roman alphabet, for Christianity (which then meant civilization) came first to England from the Irish Church, both directly from the west and through its Scotch missionaries. This writing had considerable modifications of the Roman type, some Runic forms being introduced.

See the column called "Saxon" (that is, strictly speaking, Old English) in the text illustrations to ALPHABET.

ERSKINE, EBENEZER, founder of a sect of seceders from the Established Church in Scotland called the Secession Church, was born 22nd June, 1680. He studied at the University of Edinburgh, became a licentiate in divinity in 1702, and in 1703 was chosen minister of Portmoak in the shire of Kinross, whence in 1731 he removed to a charge in the town of Stirling. The secession of the body headed by Mr. Erskine was occasioned by the operation of the Act of Queen Anne restoring lay patronage in the Church of Scotland. The presbytery of Kinross, led by Erskine's brother Ralph, had refused to induct a presentee forced on an objecting congregation by the law of patronage. In 1732 the General Assembly enjoined the presbytery to receive the presentee, and passed an Act of Assembly regulating inductions. Against this Act Mr. Erskine preached, for which it was decided by the assembly that he should be "rebuked and admonished," and finally he was suspended from his functions. Erskine and his friends, including his brother Ralph, formally seceded in 1736. When the secession was divided into the two sects of burghers and anti-burghers Mr. Erskine and his brother were of the party of the former. He died 22nd June, 1756.

ERSKINE, LORD THOMAS, was the third and youngest son of David, earl of Buchan. He was born in January, 1748, and received the rudiments of his education partly in the High School of Edinburgh, and partly at the University of St. Andrews. In 1764 he entered the navy as a midshipman, but in 1768 he accepted a commission in the first regiment of foot, and subsequently went with his regiment to Minorca. In 1775, at the solicitation of his mother, but it is said against his own judgment, he commenced the study of the law, and entered himself a student of Lincoln's Inn. He became the pupil of Mr. Buller, and afterwards of Mr. Wood, both of whom were subsequently raised to the bench. In Trinity term, 1778, Mr. Erskine was called to the bar, and his success was rapid and brilliant. In the same term he was employed as one of the counsel for Captain Baillie, lieutenant-governor of Greenwich Hospital, who was prosecuted for an alleged libel on the other officers of that establishment. The prosecution was in fact instituted by Lord Sandwich, then at the head of the admiralty, who had abused the charity by appointing landsmen as pensioners to serve his own electioneering purposes. Mr. Erskine's eloquent and indignant speech at once established his reputation. In 1783, when he had been scarcely five years at the bar, he received a patent of precedence at the suggestion of Lord Mansfield, who then presided in the Court of King's Bench. In the same year Mr. Erskine was returned member for Portsmouth, through the interest of Mr. Fox, but in the House of Commons his success by no means equalled the expectations his friends had formed, though his parliamentary speeches would appear to have been far above mediocrity. In the same year also he was made attorney-general to the Prince of Wales, an appointment which he was called upon to resign in 1792, in consequence of his refusing to abandon the defence of Thomas Paine when he was prosecuted for his publication, "The Rights of Man." In 1802 he was made chancellor of the duchy of Cornwall, and in 1806, on the formation of the Grenville ministry, he was appointed lord chancellor, and raised to the peerage by the title of Baron Erskine. He was ill fitted for the judicial duties of the chancellorship. On the dissolution of the ministry in 1807 he retired from public life. In 1820 he took a prominent part in the House of Lords on the occasion of the trial of Queen Caroline. In the latter years of his life he was harassed by pecuniary embarrassments. His first wife died in 1805, and he married again. He died 17th November, 1823.

Lord Erskine's talents were peculiarly those of an accomplished and dexterous advocate; his addresses to juries captivated their understandings, their imaginations, and their passions; they were marked by strength, vigour, and simplicity, and a perfect freedom from colloquial vulgarisms. His extraordinary talent was developed by the circumstances of the times; his indignant eloquence was called forth in defence of those individuals in whose persons the government attacked the liberty of the press and constitutional freedom. The public mind was in a state of ferment from the recent events of the French Revolution. As counsel for the defendants in these political prosecutions Lord Erskine made his noblest and most successful efforts. Fearless and zealous in the cause of his client he spoke home truths without using unnecessary violence or low invective.

ERU'CA, a genus of plants belonging to the order CRUCIFERÆ. The species are annual branched herbs, with erect terminal racemes of flowers, which are white and yellow, and remarkable for their beautiful reticulation of brown veins. *Eruca sativa* (garden rocket) is a native of cultivated fields and waysides in the north of Africa and southern Europe. In height it varies from 3 inches to 2 feet, and the flowers are very variable in the depth and arrangement of their colours. When full grown it has an acrid and unpleasant taste, and a strong, peculiar, almost fetid smell; but when young and tender, it is frequently eaten on the Continent as a salad.

ERU'CIC ACID, a fatty acid contained in the oil expressed from white mustard (*Sinapis alba*). It is obtained in crystalline needles, melting at 34° C. (93° Fahr.), and is soluble in alcohol. The formula is $C_{22}H_{42}O_2$. It forms a series of salts.

ERUP'TION. See VOLCANO.

ERYN'GIUM, a genus of plants belonging to the order UMBELLIFERÆ. The species are usually perennial spiny herbs, with the flowers congregated into oblong or roundish dense heads, the base of which is surrounded by a whorl of conspicuous bracts, which are generally spiny. *Eryngium maritimum* (sea holly) is a native of Europe, on the sands of the sea-shore, and is found on the European and African shores of the Mediterranean Sea. It is abundant on the eastern shores of England, and is found in Scotland and Ireland. The plant is called in England Sea Eryngo, Sea Hulver, and Sea Holme. The flowering shoots are very good when boiled and eaten like asparagus. The leaves are sweetish, with a warm aromatic flavour. The root also is sweet to taste, and has an aromatic smell. It has been used in medicine as a tonic, and regarded as a valuable aperient and diuretic. The root is candied, and is sold in the shops of London as a sweetmeat. *Eryngium campestre* is a more bushy and slender plant than the last. It grows on waste ground and in dry sandy fields, and is a very common plant in the south of Europe. It is found in England and Scotland, but is a rare plant. *Eryngium fœtidum* is a native of Jamaica, Cayenne, Demerara, Florida, and Brazil, in fields and woods. The negroes and poorer whites in Jamaica regard this plant as a valuable remedy in hysterical fits; hence in the West Indies it is called Fitweed. It is administered in the form of a decoction or infusion of the whole plant. *Eryngium aquaticum* (rattle-snake weed) is a native of North America, from

Pennsylvania to Virginia. It is also found in the Society Islands, California, and Buenos Ayres. It inhabits marshes, inundated pastures, and the banks of rivers. This plant is employed in North America as an application to the bite of a rattle-snake; hence its common name. The species of this genus are most of them handsome and ornamental plants, and worthy of cultivation.

E'RYON is a genus of Crustaceans belonging to the long-tailed section (*Macrura*) of the order DECAPODA. This genus is only known in a fossil state, being found in the Jurassic strata, commencing in the Lias and culminating in the middle Oolites. Only one species has been discovered, viz. *Eryon Cuvieri*. It occurs in the lithographic limestone of Pappenheim, in Bavaria, and in the margraviate of Anspach. The carapace is very large and wide and nearly square. It is finely granulated above, marked by two deep and narrow notches on the two latero-anterior borders, and finely crenilated on the latero-posterior borders. Both pairs of antennæ are very short. The chelæ are long, but slender and feeble. The second and third pairs of thoracic limbs are provided with pincers. The abdomen is short.

ERYS'IMUM, a genus of plants belonging to the order CRUCIFERÆ. The species are annual, biennial, or perennial herbs, with variable leaves, and elongated, terminal, many-flowered racemes. *Erysimum cheiranthoides* (worm-seed, treacle-mustard) is a native of Europe, and also of North America. It is rarely found in Great Britain; it inhabits cultivated ground, waste places, and osier holts. It varies greatly in size according to situation. The flowers are very numerous, small, and yellow. It has obtained its name Worm-seed from the fact of its seeds being sometimes used as a remedy for intestinal worms. It was also formerly employed as an ingredient in the famous Venice treacle, and hence the whole genus has been called Treacle-mustard. There are eighty or ninety species of Erysimum, most of them natives of Europe, and a few of the temperate districts of Asia, Africa, and America. Some of them are ornamental and worthy of cultivation.

ERYSIP'ELAS (also called *Ignis Sacer*, *the Rose*, *St. Anthony's Fire*), an inflammation of the skin, occasioning a spreading redness, which occupies a broad surface, on which are formed vesicles or blisters, preceded by and accompanied with fever. The whole of the inflamed surface is painful, but the pain is not acute; it is rather a sensation of burning or stinging than of severe pain. The redness is not intense, like that produced by phlegmon or boil, but is of a pale rose colour. There is always considerable tumefaction; the tumour is not surrounded by a definite boundary, but is diffuse, irregularly circumscribed, and unattended with a sensation of throbbing. The tumour is often soft and boggy. It is characterized by the vesications which form upon it.

Two different kinds of erysipelas are usually recognized, *idiopathic* or medical erysipelas, arising from constitutional causes, and attacking chiefly the head and face; and *traumatic* or surgical erysipelas, which follows a wound or injury, and may occur in any part of the body.

Erysipelatous inflammation is characterized by its tendency to spread, and thereby to cover a considerable portion of the external surface of the body. It creeps on in succession from one part of the skin to another until it extends to a great distance from the part originally attacked, the inflammation often disappearing from the former as it becomes established in the latter. The disease is always more severe when it attacks the head than when it is seated in any other part of the body.

An attack of idiopathic erysipelas generally comes on either with chills or a distinct cold shivering, attended with a sense of lassitude, aching in the limbs, restlessness, and that disordered state of the skin which has been expressively termed febrile uneasiness. There is from the beginning uneasiness or confusion in the head, which soon amounts to decided pain. This is accompanied with such a degree of drowsiness that the attack may sometimes be predicted long before there is any appearance of redness or swelling in the face, from the inability of the patient to keep himself awake. The chilliness is soon succeeded by heat of skin; the appetite fails, the bowels are constipated, the tongue is dry and parched, there are sometimes nausea and vomiting; the pulse is always frequent, sometimes full, soft, and compressible, but occasionally hard and tense.

The progress of the disease is more or less rapid, and its duration longer or shorter, according to the age, the temperament, and the vigour of the individual. In the young, the sanguine, and the robust, the tumefaction is sometimes fully formed on the second day, and the whole terminates on the sixth or seventh, while in the aged and the less vigorous it may be protracted to the tenth or twelfth, and the desquamation may not be completed before the fourteenth day. The average duration of the disease may be stated to be from eight to ten days. When the fever and inflammation are intense delirium comes on, which sometimes rapidly passes into coma. When death does not take place, the inflammation, after having affected a part, commonly the whole of the face, and perhaps the other external parts of the head, ceases. With the inflammation the fever also ceases; and, without any evident crisis, the patient returns to his ordinary state of health.

The exciting causes are exposure to cold and moist air after the body has been previously heated; exposure to sudden and great alternations of temperature; exposure to great heat, however produced, whether by the direct rays of the sun or by a fire; intemperance; unwholesome articles of diet, as shell-fish or stale and rancid fish; rich, oily, fat, or smoked meats; impure states of the atmosphere; an impure state of the body, arising from a morbid condition of the blood, in consequence of the suppression of its depurating processes, whence the frequent occurrence of the disease in the advanced stages of fever, greatly complicating the state of fever and exhausting the little remaining strength of the patient. Violent emotion of mind has also been observed to be an exciting cause of erysipelas in those powerfully predispsoed to the disease; in whom also local irritants often induce it, as wounds or punctures in the skin, the bites of leeches, the stings of insects, inoculation with variolus or vaccine matter.

In the treatment of erysipelas it is generally necessary to cleanse the bowels at the commencement of an attack, but as it is essentially an exhausting disease, lowering treatment is seldom or never admissible. The diet should be as nourishing as possible, and should consist of such articles as beef-tea, beaten eggs, milk, &c., as solid food can never be taken during the progress of the disease. In many cases stimulants are required from the outset, sometimes in large quantities, while tonic medicines, such as bark, ammonia, and quinine, are often useful. The drugs that are chiefly relied on in the treatment of this disease are the tincture of the perchloride of iron and aconite. By many physicians the former is regarded almost as a specific for this disease. When employed it is administered in large doses, 40 minims in a little water being given every four hours at the commencement, the quantity being reduced as the symptoms abate. Aconite when administered quite at the commencement will often cut short an attack of erysipelas, and where it fails to do this its influence over the inflammation is frequently of a very marked character. Its effects must be carefully watched, however, so as to avoid a dangerous depression of the system. Local treatment should be directed towards the avoidance of variations of temperature, and for this purpose it is often found useful to cover the affected part with a layer of dry cotton wool.

ERYTHE'MA, a superficial redness of some portion of the skin, varying in extent and form, attended with disorder of the constitution, without vesications, and uninfectious. It is distinguished from erysipelas by the slight degree of constitutional disorder and local pain, by the more uniformly favourable termination of the disease, and by the absence of tumefaction and vesication.

The primary causes of erythema are the friction of contiguous parts, especially in fat persons; the accumulation of morbid secretions and excretions on the skin, as the matter of the perspiration, of the leucorrhœal discharge, of the catamenia, and of the fæcal and urinary evacuations in the adult in the course of other diseases, and in the infant in consequence of a want of proper ablution. It is also constantly produced by irritating articles of food and drink, and is the sign and the result of a disordered state of the digestive organs.

In most cases the affection disappears soon after the removal of the cause which produces it—by free ablution where it is the result of irritating matters on the skin, and its disappearance is assisted sometimes by the application of an absorbent powder to the inflamed surface, and at other times by the use of a gently stimulating lotion, as the spirit wash. When the disease is dependent on a disorder of the digestive organs, it can be removed only by the remedies proper for the removal of the stomachic, the hepatic, or the intestinal derangement. For the restoration of these organs to their sound condition the most appropriate remedies are light diet, diaphoretics, the mercurial alteratives in combination with gentle aperients, and the mineral acids as tonics.

ERYTHRÆ'A, a pretty genus of annual plants, belonging to the order GENTIANACEÆ, and inhabiting dry sandy places in Great Britain and other parts of Europe, especially near the sea. They are extremely bitter, and are collected by country people, under the name of centaury, as a substitute for gentian in domestic medicine.

Erythræa Centaurium (centaury), an indigenous plant, common in dry pastures, flowers in July and August, at which time it should be collected. It contains a principle called *centaurin*, which, united with hydrochloric acid, furnishes an excellent febrifuge medicine. In this genus the calyx has five divisions; the corolla is funnel-shaped, with five short lobes, twisted in the bud; five stamens, with erect anthers, which are at length spirally twisted; the style is simple, deciduous, with two stigmas, and the capsule imperfectly two-celled.

ERYTH'RIC ACID or **ERYTH'RIN**, an acid obtained from the lichen *Roccella tinctoria*, and also found in some other lichens used in the preparation of the purple colouring matter known as archil. It is obtained as a white crystalline powder from the solution of the plant in boiling water. It is very soluble in alcohol and ether. The formula is $C_{20}H_{22}O_{10}$. It is a weak acid, forming unstable salts with the alkalies and alkaline earths.

ERYTHRI'NA. See CORAL TREE.

ERYTHROX'YLON. See COCA.

ERZEROUM' or **ERZRUM'**, a town in Turkish Armenia, in a high plain near the left bank of the Kara-su, a feeder of the Euphrates, about 110 miles S.E. of Trebizond, and 90 from the Black Sea. It is surrounded on all sides by very lofty mountains, some of which are covered with perpetual snow, and consequently the winter is very severe, the whole city being literally buried in snow for five or six months. The town, which is entered by four gates, is very large, and is partly surrounded by an old castellated wall, and on its southern skirts stands a citadel encircled by a double wall flanked with towers. The houses for the most part are low and built of wood, but the bazaars are extensive and well supplied with provisions. Erzeroum has nearly forty mosques, several khans, a Greek church, and a large Armenian chapel. The population was estimated in 1827 at 130,000, but the town being soon afterwards occupied by the Russians the greatest part of he inhabitants abandoned it. After its restoration to the Turks by the peace of Adrianople the place rose from its state of decay, and the population was estimated at 60,000 in 1884. Before the Russian invasion considerable quantities of silk and cotton cloth were made here, and much leather tanned; there were also some manufactures of copper vessels.

Erzeroum is important as a commercial town. Besides the produce of its manufactures it exports corn, cattle, sheep, and dried meats. But it derives other commercial advantages from its being situated on one of the most frequented caravan roads of Western Asia, which leads from Persia and Georgia to the great commercial towns of Asia Minor. This renders Erzeroum an important place also in a political and military point of view. After the capture of Kars in the war of 1877–78 Erzeroum was invested by the Russians, and one of the conditions of the armistice at the conclusion of the war was that it should be temporarily occupied by their troops. It was, however, afterwards restored to Turkey.

Erzeroum was founded about 415 by a Byzantine general of Theodosius II., after whom it was named *Theodosiopolis.* It derives its present name from the ancient *Arze* or *Ardzen*, a populous city which stood not far to the east, but which, having been destroyed by the Seljukians, the surviving inhabitants transferred their residence and the commerce and name of their city to the present site.

ERZ'GEBIRGE ("ore or metallic mountains"), a mountain range of Germany, dividing Bohemia from Saxony, and extending in a W.S.W. direction from the Elbe, which divides it from the Riesengebirge to near Eger, where it joins the Fichtelgebirge and Frankenwald. They link on with the Sudetic mountains, and thus unite the Carpathian system with the numerous irregular chains of South Germany; length, about 100 miles. The culminating point is the Sonneburbel or Schwartzwald, 4124 feet high. Its southern declivity, which is steep and intersected with narrow valleys, terminates in the valley of the river Eger, about 10 or 15 miles from the upper range. The northern declivity of the range descends in more gentle slopes towards the great plain of Northern Germany; and these slopes are divided from one another by wide valleys.

The range of the Erzgebirge belongs to the primitive formation, granite and gneiss being everywhere prevalent, except along the Elbe, where sandstone almost exclusively occurs.

The range abounds in mines of silver, tin, lead, iron, cobalt, copper, &c., which afford employment to upwards of 200,000 persons. The silver mines are at Schneeberg, Schwarzenberg, Annaberg, and Marienberg. The most considerable tin mines are at Altenberg, Geier, and Schneeberg. The most productive iron mines are those of Johann-Georgenstadt. Near Aue and Bockau, to the south of Schneeberg, lie the largest cobalt mines and smalt (or blue colour) works in Germany; of these smalts the yearly produce is between 9000 and 10,000 cwts., besides large quantities of arsenic, &c. The white porcelain earth used in the royal china manufactory at Meissen is procured and prepared in this district. Sulphur and vitriol are made at and near Beierfeld and Geier; magnesia and porcelain earth are obtained at Elterlein; and there are coal mines of importance at Planitz and other spots near Zwickau. Gold is found in some places, but no mines are worked.

ESAU ("hairy," "rough"), the ancestor of the Edomites was the son of Isaac and Rebekah and the elder twin brother of Jacob. He appears to have been a thorough Bedouin or son of the desert—bold, rough, hardy, of a heedless disposition, and with but little care for the future. These characteristics are fully illustrated in the narrative recorded Genesis xxv. 29–34, where he falls a ready victim to the

cunning selfishness of his brother, and for a bowl of lentils parts with his birthright. He married at the age of forty two Canaanitish wives, who became a grief of mind to his parents. The next incident in his history is that of the successful plot of his mother and brother to defraud him of the covenant blessing, an event which caused him bitter grief, and awoke a determination to kill the brother who had twice supplanted him. After the flight of Jacob Esau married his cousin Mahalath, the daughter of Ishmael, in the hope of pleasing his parents, and soon after this he appears to have established himself as an independent chieftain on Mount Seir. He was residing there when Jacob returned from Padanaram, and came to meet his brother at the head of 400 men. He seems to have completely forgiven his brother's early offences, and after an affectionate greeting offered him an escort on his way homewards. On the death of Isaac he joined with Jacob in burying the body of his father, and afterwards went away into Mount Seir from the face of his brother Jacob. To the Western mind the character of Esau contrasts very favourably with that of Jacob in all but the later stages of the life of the latter. By some modern critics the story of the relationship of the two brothers is regarded as being of a mythical character, originally suggested by the character of the district of Edom and the various tribes which dwelt there.

ES'CALADE, in military affairs, is the name given to an attack upon an enemy's fortification by a storming party provided with ladders, by means of which they endeavour to descend into the ditch, and afterwards to scale the face of the works. The ladders used for this purpose are made in lengths and provided at the ends with sockets, so that one can be added to another when required. It is usual for a firing party to be told off where the attack is made to keep down the fire of the defenders, but now that breechloading and magazine rifles are in general use, an escalade is generally attempted at night, so that the attacking party may be protected by the darkness.

ESCAPEMENT, that part of a piece of machinery which provides for the return of the moving part under the influence of the moving force. In clocks, &c., it is the means whereby the constant rotatory force is made to turn into a to-and-fro motion. The dead-beat escapement of a clock is a very familiar example; the pendulum carries a double clutch, the arms of which fall alternately between the teeth of the escapement wheel as the pendulum swings to and fro. The wheel therefore escapes to the extent of one cog length at each vibration, the clutch stopping it from going further at a time.

ESCARP'MENT is the name applied to a line of cliffs with a steep slope on one side (the scarped side) and a gradual slope on the other, generally much the same as the dip of the strata composing the cliff. Instances of escarpments are very common in all parts of the world; our own island affords numerous excellent ones. The Cotswold Hills constitute a great Oolite escarpment overlooking a plain of Lias clay and new red marl, while the Oolitic plateau is in turn overlooked by the chalk escarpment of the Chiltern Hills. The Weald affords a most instructive example of escarpments. Starting from the Sussex coast and going northwards we should arrive at the edge of the South Downs, a sharply marked chalk escarpment overlooking the Lower Greensand; continuing in the same direction along this formation, we should find that it ended in a smaller but well-marked escarpment overlooking a plain of Weald clay. Crossing a central ridge of Hastings sand we should again come upon a plain of Weald clay, and after traversing this we should have to ascend an escarpment of Lower Greensand, and after this should arrive at the strongly marked chalk escarpment of the North Downs.

ESCHAROT'ICS are agents applied to the surface of the body which destroy the vitality of the part which they touch, and produce an eschar. They may be classed under two heads, the *potential cauterants* and the *actual cauterants*. The former are chiefly chemical agents. The actual cauterants are substances of an elevated temperature, which decompose the part which they touch, and completely destroy its organization. The chief potential cauterants are strong mineral acids, such as the sulphuric or nitric, pure alkalies, and some metallic salts, especially nitrate of silver or lunar caustic. These are used either to produce counter-irritation, or to remove fungous or morbid growths. Lunar caustic seems to possess peculiar properties, and is unquestionably one of the most powerful direct antiphlogistic agents known. The actual cauterants are used either for their primary action, viz. the immediate destruction of the part, or for their secondary effects. The former object is rarely attempted, except to prevent the absorption of any poisonous or contagious matter, as the venom of a snake or bite of a mad dog. The secondary effects are more important, and more varied according to the degree of heat of the substance applied. The increased action is frequently felt through the whole frame. Torpor and paralysis of the nervous system often disappear, and neuralgia both of the neighbourhood and even distant parts is removed. Atony and laxity of the muscular system vanish, and every part displays more energy and power. The actual cautery may be applied in a variety of ways, viz. hot vapour, moxa, and heated iron. The first of these is a very ready means of causing vesications in some diseases.

The eschar which follows the application of the potential or actual cautery generally suppurates in a few days. The ulcer is then to be treated with different agents, according as it is wished to heal it or keep it open, as a further means of counter-irritation.

ESCHEAT' is from the Norman French *eschet*, which is from the word *eschier* or *eschoir*, to fall. It was a feudal penalty whereby, if the vassal's heirs failed, the land escheated (*i.e.* reverted) to the lord. Escheat also occurred if the vassal committed a crime, but in this case, if it was an act of treason, the lands went to the crown, and were said to be *forfeited*. This was felt to be so unjust to the immediate lord that Magna Carta provides that the crown tenure of escheated lands of traitors should be only for a year and a day. The immediate lord then took possession. By an Act which came into operation in 1834, it was provided that there should be no escheat on failure of the whole blood, wherever there were persons of the half-blood capable of inheriting under 3 & 4 Will. IV. c. 106. s. 9. If a bastard dies intestate and without issue, his lands escheat to the lord of whom they are held.

The words escheat and forfeiture are often carelessly used. Escheat arises solely because there are no heirs to take the land, for one or the other of the two reasons stated above. Forfeiture is a direct consequence of an illegal act. Forfeiture for treason and felony was abolished in 1870.

In Scotland escheat was a common occurrence in feudal law, and also under denunciations on letters of horning for failure to pay civil debts. But it is now nearly a matter of historical interest, with little practical effect.

ESCORIAL' or **ESCURIAL'**, a small town of Spain, in the province and 24 miles north-west of Madrid, celebrated for the magnificent palace of the Escurial, an enormous edifice built by Philip II. in 1563, in the form of a gridiron, to commemorate the martyrdom of San Lorenzo, who was said to have been broiled to death. It was chiefly in the Doric order of architecture. The length was about 250 yards, and breadth 200 yards. Externally it was sombre and heavy, with many small windows, but the magnificence of the interior decorations was almost unequalled. The most striking part was the church in its centre. It was built with a cupola and two towers, after the manner of St. Peter's at Rome; its dome was 330 feet high. It contained also a convent, library, a magnificent royal mausoleum (containing

the remains of Charles V., Philip II., and many other kings of Spain), several priceless frescoes, pictures, and other artistic treasures (but many of those formerly here have been removed to Madrid or lost by fire or sack), and the royal apartments. This magnificent relic of the days of Spanish greatness, which overlooked a wide and most striking landscape of plain and mountain, was almost entirely destroyed by an accidental fire in 1886.

The name of the place, according to Casiri, is of Arabic origin, signifying a place *full of rocks;* though others derive it from a Spanish word implying the *scoriæ* or scum of melted metal, some iron mines having been formerly wrought in the locality. Its situation certainly bears out the former etymology. It has a most gloomy site, surrounded by the bare crags of the Sierra Guadarrama.

ES'CUAGE or **SCU'TAGE,** a pecuniary payment as a commutation for knight-service, by which service the tenant was bound to follow his lord to the wars at his own charge. The term is from the Old French *escu* (Lat. *scutum*, a shield). By the 25 Edw. I. it was enacted that the king should take no aids but by the common assent of the realm. [See also MAGNA CARTA.] These scutages seem to be the origin of all succeeding subsidies, and of the land-tax of later times.

ES'CULIN or **ÆS'CULIN,** a crystalline substance contained in the bark of the horse-chestnut (*Æsculus hippocastanum*). It is obtained from the aqueous extract in colourless crystalline needles, soluble in water and alcohol, but insoluble in ether. The formula is $C_{21}H_{24}O_{13}$. It is a glucoside, and is decomposed by boiling with dilute hydrochloric acid into glucose and esculetin ($C_9H_6O_4$). The solution of esculin is remarkable for its high fluorescent property, emitting a beautiful blue colour by reflected light. The fluorescence is increased by alkalies, but destroyed by acids.

ESCUTCH'EON, the heraldic term for the shield, on which, under every variety of shape, arms are emblazoned. The word is derived from the French *écusson*, and that from the Latin *scutum.* An *escutcheon of pretence* is the small shield in the centre of his own, on which a man carries the coat of his wife, if she is an heiress and he has issue by her. In this case the surviving issue will bear both coats quarterly.

As the keyholes of locks are frequently protected by a shield-shaped plate of brass, this is called an escutcheon, and the term now serves for any keyhole plate, of whatever shape.

ES'DRAS, BOOKS OF. In the Vulgate the first Book of Esdras means the canonical book of Ezra, and the second the canonical book of Nehemiah, according to the early Hebrew arrangement, and the third and fourth books are what in the Apocrypha we term the first and second books of Esdras. The first book consists of a compilation from the canonical books of Chronicles, Ezra, and Nehemiah, with additions and alterations. Its date and authorship are unknown, but it was in existence at the time of Josephus, who follows its order of events instead of the order given in the canonical scriptures.

The second book of Esdras is of an apocalyptic character, and is wholly different from the first book. Originally written in Greek, the first text has been almost entirely lost, but the book was preserved for a long period by means of an old Latin version which was retained in some MSS. of the Vulgate, and five distinct versions, viz., Latin, Syriac, Ethiopic, Arabic, and Armenian, are now known to European scholars. In the Vulgate there are four chapters, two at the commencement and two at the close of the book, which are wanting in many of the best MSS. and in all the Eastern versions, while eighty-three verses contained in the Arabic and Ethiopic versions are wanting in the Vulgate. The book consists of a series of revelations and visions dealing with the future of Jerusalem, the coming of the Messiah, and the last things. It was assigned to the prophet Ezra by Clement, and it is referred to as authoritative by Cyprian, Athanasius, and others; but it is condemned by Jerome, and it does not occur in any list of canonical writings. There is a wide divergence of opinion among critics as to the date and authorship of this book, but with the exception of the opening and closing chapters already referred to, which are evidently Christian additions, there is a general agreement as to its being the work of a Jewish author, probably one of the sect of the Pharisees. Its date has been placed as early as 28–25 B.C., and as late as 218 A.D., but the opinion most generally received is that which assigns it to the close of the first century.

E'SHER, a pleasantly situated village, 13 miles south-west of London by the London and South-western Railway, and 3½ miles from Kingston, occupying a gentle eminence, backed by the old woods of Claremont Park. The old church is of great antiquity. One of its three bells is said to have been brought from San Domingo by Sir Francis Drake. At Esher an episcopal palace was erected by Waynflete, bishop of Winchester, about 1460, which was repaired and rebuilt by Cardinal Wolsey in 1528. It afterwards passed through many hands to the Pelham family, and Henry Pelham, the prime minister of George I., resided here for many a year. The gardens were then laid out by Kent, and Pope refers to

> "Esher's peaceful grove,
> Where Kent and nature vie for Pelham's love."

The old palace was pulled down in 1803, but the original gateway built by Wolsey still remains, a square tower of brick, with octagonal turrets at the angles.

ES'KARITES (Arab. *aschraca*, to shine like the sun), among the Mohammedans, a sort of Platonic philosophers whose principal doctrine is that of placing their highest happiness and chief good in the contemplation of the great Omnipotent. They are devoted to poetry and, music, and pride themselves on their morality and general placidity of temper.

ES'KER is the name given in Ireland to curious mounds and ridges of gravel and sand overlying the boulder clay. They frequently have a distinctly stratified appearance, sometimes they can hardly be told from moraine-heaps. The ridges, which at times are from 20 to 30 feet high, sometimes cross valleys and even watersheds, running for some miles. Occasionally two will coalesce, inclosing a basin-shaped hollow sometimes filled with water. Similar structures are found in Scotland (where they are called *kames*), notably in the Clyde valley; in Scandinavia (where they are known as *ösar*); also in Yorkshire, Northumberland, and Lancashire. No satisfactory account of their origin has as yet been given.

ES'KIMO, a nation inhabiting the Arctic coasts of America and Asia. On the eastern coast of America they are met with as far south as 50° N. lat., on the shores of the Strait of Belle Isle, which separates Newfoundland from the mainland of America. They occupy the whole of the great peninsula of Labrador, and the whole eastern coast of Hudson Bay up to East Main River. On the western side of Hudson Bay they inhabit the coast north of Churchill River, whence they extend northwards over the Barren Lands to the Great Fish River, on both banks of which river they are found east of 100° E. lon. The whole country between this river, the Great Bear Lake, the Mackenzie River, and the Arctic Ocean, is exclusively inhabited by them. The coast lying to the west of Mackenzie River is in their possession, and they also occupy Greenland and all the habitable ground between the northern coast of America and the pole, and a small portion of the Asiatic shore of Behring Strait. In the Arctic expedition under Captain Nares, in 1875–76, no traces of them were found beyond 81° 52′.

The Eskimos are said to be from 5 feet 4 inches to 5 feet 10 inches in height, and even to attain 6 feet in

rare cases. Their faces are broad and round, with a good-humoured expression, their cheek-bones high, their cheeks round and plump, mouth large, and lips thick. The nose is small and flat, the eyes black; and the eyelids, being much encumbered with fat, appear very small and deeply seated. The hair is long, lank, and of a jet-black colour. The ears are situated far back on the head. Their bodies are square and robust, the chest high, and shoulders very broad. Their hands and feet are small. They are of a deep copper-coloured complexion. They are not without beard, but they generally pluck it out as soon as it appears. Their language is different from that spoken by the other savage nations who inhabit North America; but the same language is spoken by all the different tribes of the Eskimos, though of course each of them has expressions which are peculiar.

The Eskimos are very clever with their hands, making the simple articles they require neatly and well. They are decidedly dirty in their personal habits, washing, except accidentally, rarely extending beyond a rub on the face with a piece of dry cotton, while the floors of their huts are generally in the most disgusting state. These are constructed of planks covered over with green turf, and are very low: one of the first salutations a stranger frequently receives implies a warning to beware of striking his head. Temporary buildings are sometimes made of blocks of snow with a sheet of ice for a window. Public offences against law or morality are very rare, but the women are said to be very lax in private. Lying is also said to be very common, and though stealing is not frequent among themselves, they are said not to have very clear notions as to the property of strangers. The religion, especially in Greenland, is nominally Christian, but they are really believers in a religion chiefly founded on the deification of natural objects, and they are very superstitious. Though nervously anxious to avoid giving offence to those with whom they are on amicable terms, they are not wanting in courage, and are very revengeful if they are injured. There have been many surmises as to their origin, some holding that they are the descendants of Europeans of the

so-called Drift period, others that they are an Indian race driven gradually northwards in very early times.

Eskimo is the Lochieux Indian name, signifying "flesh-eaters," applied to the inhabitants of the extreme northern regions of America and the Asiatic side of Behring Strait. They call themselves "Innuit" (the people).

ES'KIMO DOG is a variety of Dog found in the northern Arctic regions of North America and Asia. These dogs resemble very nearly in form and colour, and nearly equal in size, the gray wolf of the Arctic circle, from whom it is most probable they are descended. The muzzle and ears are pointed, the hair is long and rather curling. The colour varies considerably. These dogs are invaluable to the Eskimos. They are used principally for drawing sledges, but are extremely savage and wolfish. The treatment they receive from their masters, however, is most brutal. Little or no care is taken of them, and in the summer, when their services are not required, they are turned adrift to forage for themselves.

ES'OTERIC. See Exoteric.

ESPAL'IER, a trellis for training fruit trees or bushes upon, instead of nailing them to walls.

In certain situations this kind of training is not only extremely neat, but possesses peculiar advantages: the trees are more fully exposed to the influence of light, less liable to be broken by high winds, and in small gardens in particular, where room is of great importance, and where a collection of the finer sorts of fruit is always desirable, it is found highly useful, both on account of the small space which the trees occupy, and because they will bear fruit much sooner than when allowed to grow in their natural form. The objection to iron trellises is, that they cut and canker the trees; and when the cheapness of the wooden one is considered, besides the more natural appearance which it presents, it must undoubtedly have the preference.

ESPAR'TO GRASS. A long and beautiful grass (*Stipa tenacissima*) found in great abundance in many parts of Spain. It grows freely upon the sea-coast, and especially upon the hill-ranges of Murcia; also in Algeria and some other parts of the northern coast of Africa. The grass to look at is like a rush; its characteristic is its marvellous toughness and tenacity. It grows in thick bunches close together, and reaches the height of 6 to 10 feet. The harvesters go out over the mountains in July or August and pluck and pack it upon mules. It is a crop that cannot be cut. It must be plucked out of the socket by hand, for if cut the plant invariably dies away. Pulling up by the roots is also equally fatal to it. These mistakes, and the attempting to pluck too early, before the grass is matured sufficiently to quit the socket without injury, gave rise to an idea that the esparto was rapidly decreasing. If treated properly, however, the crop should not decrease.

In the exhibitions of 1851 and 1862 specimens of this grass and of paper made from it were exhibited and commended. After 1862 it came into general use in England as the best substitute for rags in making paper. In 1856, when first introduced, about 40 tons were imported, and now the consumption has risen to more than 200,000 tons per annum. The first price was £4 a ton; it now fetches £10, and even more. The Spaniards make use of it only for local purposes, such as the manufacture of sandals, ships' cordage, mats, baskets, nets, &c. It is supposed, with good reason, to be the "spartum" described by Pliny, which, he says, was first applied to useful purposes by the Carthaginians in their first war in Spain. It was then growing so abundantly in the part of Spain called Spartarius Campus, reaching from Granada to Murcia, that the mountains were covered with it. Esparto grass grows on the poorest soil, especially limestone and sand—in fact, where nothing else will grow this will flourish. It may yet form an inexhaustible source of wealth to all northern Africa, and Dr. Schomburghk, one of the most eminent authorities upon industrial botany in Australia, is of the

opinion that it would render thousands of acres in that country most productive which are now scarcely fit for pasture. See PAPER.

Molinia cœrulea, a grass which grows on wet heaths in the British Isles, has been found to be a good substitute, and has been called Irish Esparto Grass. The small amount of silica in the ash, only 0·55 per cent., is a valuable feature. This grass has been planted in Galway with some success, and if the lands in Ireland, over 1,000,000 acres, which now produce scarcely anything of any value, were utilized in this way, it is calculated that each acre would produce half a ton of this grass, which at its lowest value would be worth £2.

ESPLANADE, the ground between the fortifications of a citadel and those of the town to which it belongs. The term is also commonly applied to open spaces for walks and drives, especially along the sea wall of coast towns.

ES'QUIMAUX. See ESKIMO.

ESQUIRE (from the Old French *escuier*, shield-bearer) is the next title or dignity to that of knight. The esquire was the second in rank of the aspirants to chivalry or knighthood, and had his name from carrying the shield of the knight, whose bachelor, or apprentice in arms, he was. The esquire was a gentleman, and had the right of bearing arms on his escutcheon or shield; he had also the right of bearing a sword, which denoted nobility or chivalry, though it was not girded by the knightly belt; and he had besides a particular species of defensive armour, which was distinguished from the full panoply of the knight.

The sons of younger sons of dukes and marquises, the younger sons of earls, viscounts, and barons and their eldest sons, with the eldest sons of baronets and of knights of all the orders, are all said to be esquires by birth, though their precedence, which differs widely, is regulated by the rank of their respective ancestors. Officers of the queen's court and household, and of her navy and army down to the captain inclusive, doctors of law, barristers, and physicians, are reputed esquires. The general assumption of this title by those who are not in strictness entitled to it has virtually destroyed it as a distinct title or dignity. It is now usual to address men of any acknowledged standing, or indeed any men whatever to whom respect is desired to be shown, as esquires on the outside of a letter.

ESSAY. This title is customarily confined to a certain class of short composition upon subjects of general interest, as morals, criticism, manners, &c. The notion of a series of such papers fit for general circulation, in a journal either (as the *Tatler*) including or (as the *Spectator*) not including news or politics, was originated by Steele and Addison. The following are the most celebrated series of English Essays:—*Tatler*—Steele, Addison; *Spectator*—Addison, Steele, Budgell, &c.; *Guardian*—Steele, Addison, Berkeley, Pope, Tickell, Gay, &c.; *Rambler*—Johnson, almost entirely; *Adventurer*—Hawkesworth, Johnson, Joseph Warton, &c.; *World*—Moore, Lord Chesterfield, Horace Walpole, J. Warton, &c.; *Connoisseur*—G. Colman and Bonnel Thornton chiefly, Cowper a few; *Idler*—Johnson, a few by Warton and others; *Mirror*—Henry Mackenzie and others; *Lounger*—The same; *Observer*—Richard Cumberland, almost entirely; *Olla Podrida*—Moore, &c.; *Microcosm*—Canning, Frere, Smith, &c.

The limit upon which Steele founded the *Tatler*, the basis of this somewhat extensive superstructure, is certainly due to the versatile Defoe, who in his "Scandal Club" furnished occasionally brief comments, in the form of imaginary letters on social topics, &c., to his own *Review*. "Thus," said Defoe, "we may wheedle men into the knowledge of the world, who rather than take more pains would be content with their ignorance."

This meaning of the word departs from its true original, as it comes from the Latin *exagium*, a weighing; and is merely another form of the word "assay." This is the object of Bacon's Essays (1597), which are brief highly elaborated compositions, containing a thought thoroughly worked out and "assayed." In 1612 and 1625 these fine works were still further retouched, and many more were added. From ten the collection grew to fifty-eight. They are one of the chief delights in the English language, for excellence of expression and shrewdness of discernment. Of the later essayists Addison alone sometimes attempts the complete grasp of a subject according to the older conception, but in form Bacon aimed at sententiousness, careless whether its effort were not a little over-apparent Addison at a graceful flow and an apparent ease, the results of incessant toil. Macaulay's Essays are usually in the apparent form of biographies. "Sir William Temple" is a storehouse of information on the times of William III., and "Clive," "Warren Hastings," and "Chatham" bring the age of George III. vividly before us in varied aspects. These are detached chapters, and chapters by a master-hand, of history; destined possibly, had Macaulay lived, to take their places in his History had he continued it. In any case the title "Essays," by which these extended and detailed pieces are known, scarcely seems correct either from Bacon's view or Addison's.

The world-famous *Essais* of Montaigne form another quite distinct series of works. Pithy as Bacon, oftentimes easier than Addison, they are (or seem to be) the gossip in nightgown and slippers of an elegant scholar and a slightly sceptical man of the world. Montaigne starts with a text, but no one can tell where he will be a few sentences off. He follows the rule of the most interesting conversationalists, and diverges to right and left as interesting prospects invite him. Thus the fine essay on "Coaches" soon turns out to be a discussion, tolerably closely reasoned, on the virtues most proper to a sovereign. The style of Montaigne, from a literary point of view, is exquisite. Writing towards the close of the sixteenth century, rather before our Bacon and Shakspeare, he has had perhaps a greater influence on the French language than they on the English. He probably numbers more readers now than ever before, for his is a book which can never tire and is always welcome.

Voltaire's "Essai sur les Mœurs," and Diderot's "Essai sur les Règnes de Claude et de Néron" (Claudius and Nero), are fine specimens of the philosophical and historical essay, of the proportions adopted by Macaulay. The term is thus as elastic with our neighbours as with ourselves.

ES'SEN, a town of Prussia, in the province of the Rhine, 15 miles N.N.W. of Elberfeld, whose foundation dates from the end of the ninth century, when the Münster Kirche was founded (873) by Bishop Alfred of Hildesheim. As it is one of the oldest, it is also one of the most interesting churches in Germany, and is rich in objects of great beauty and high historic interest. The town is situated near the centre of the great Westphalian coal and iron field, and is the scene of most active industry. In the immediate vicinity are Krupp's Steel Works, which give employment to 12,000 men, reckoning those at the coal-pits, and in connection with which upwards of 800 steam-engines are daily at work. The articles chiefly made are steel rails and wheels, and steel guns, which are supplied to all the European powers. The works are considered the largest in the world, and are strictly guarded from the intrusion of strangers. There are in the town and vicinity other machine works and manufactures of various kinds; it is well supplied with educational, literary, and benevolent institutions. Population, 56,944.

ESSENCE is derived from the Latin *essentia*, a word which is used by Cicero and Quintilian, and formed from *essens*, the obsolete participle of the verb *esse*, to be. The English word essence signifies that which constitutes the being of a thing, or, in the words of Locke, that which makes it to be what it is. It is a word which should

always set the reader in an attitude of watchful suspicion; there are few philosophers who have not made it a stumbling-block on account of its diversity of signification.

ESSE'NES, the name of an obscure Jewish sect which was in existence at the commencement of the Christian era, but of which the origin and history are alike unknown. There is no distinct reference to this body in the New Testament, though some have found allusions to their practices and doctrine in Matt. xix. 12, Col. ii. 16–19, and in some parts of John, but they are described by Josephus and Philo, and briefly referred to by Pliny. The accounts, however, of both Josephus and Philo are regarded with some suspicion by modern scholars, as they appear to be designed rather to propitiate foreign criticism of the Jewish nation, than to accurately record the condition of Jewish society.

According to Josephus the Essenes arose about the middle of the second century before Christ. From the age of the Maccabees there was a continuous effort on the part of the more devout of the Jews to attain to a standard of perfect holiness. For this purpose they sought to observe all the regulations as to purity which were enjoined both by the written and traditional law, and added to this vows of perpetual Nazirhood. In their efforts to follow this course they soon found it necessary to separate themselves from all ties of friendship and family, and to form either little communities of their own in the Jewish towns or villages, or else separate establishments for themselves. By degrees a code of rules, a system of vows and degrees, and a body of doctrine were formed, and the various societies became fully established as a religious order. When fully developed the Essenes formed an exclusive society, regulated by an internal jurisdiction. They enforced a novitiate of three years, guarded admission by vows of terrible solemnity, and maintained a succession of strictly separate grades within the society itself. They enforced and practised complete community of goods, all the property a man had when he joined them, and all he might gain afterwards, being handed over to the common fund. (The attempt on the part of the early church to carry out a similar principle is referred to in the opening chapters of the Acts of the Apostles.) They renounced marriage and enforced strict rules of chastity, forbade slavery, denounced war, and from the fear of incurring pollution they declined all commerce, pursuing chiefly an agricultural life. In matters of dress they wore a distinctive costume of white linen, but they did not change either clothes or shoes until they were worn to rags. Self-denial and temperance in eating and drinking were also an essential part of their discipline, and their frugal meals were taken in common, the members standing silently round the table on which the individual portions were set. In doctrine they observed strictly most of the injunctions of the Mosaic law, but they abhorred blood, considered the anointing with oil a defilement, and interpreted the Old Testament scriptures in an allegorical manner. They had, however, a secret system of doctrine of their own, of which but little is known. It appears to have included a form of sun worship, a belief in the immortality of the soul, with future conditions of happiness or misery, a doctrine of fate, and a number of speculations respecting angelic beings. By Philo their number was estimated at about 4000, and their chief settlement appears to have been on the western shore of the Dead Sea. They disappear from history soon after the commencement of Christian history, probably becoming merged in the Gnostic sects of Christianity and the sects which arose at that time among the Jews themselves.

Of their literature, beyond one or two fragments embedded in the Talmud and Mishna, nothing remains.

ESSEQUI'BO. See GUIANA.

ESSEX, an English county, situated on the eastern coast, is bounded E. and S.E. by the German Ocean, S. by the river Thames, N. by Suffolk and Cambridgeshire, and W. by Hertfordshire and Middlesex. The length, S.W. to N.E., is 63 miles; the breadth, N. to S., at the western extremity, is 37 miles. The area is 1648 square miles, or 1,055,133 acres. The population in 1881 was 576,434.

Coast, Surface, Rivers, &c.—The bank of the Thames and the sea-coast of Essex are marshy almost throughout. From the sea to Canvey Island there occurs an almost uninterrupted series of marshes and embankments; a few cliffs are found at Leigh, Southend, the Naze, and some other spots; but by far the greater part of the coast is of a marshy character. These marshes have distinct names, such as Dagenham, Tilbury, Canvey, Burnham, Southminster, Dengey, Tillingham, and Bradwell marshes.

Many creeks run inland, so as to cut off small portions of the low land and form them into islands. Among these are—Canvey, Russelys, Haven, Gore, New England, Potten, Wallasea, Foulness, Mersey, Horsey, Holmes, and Pewit islands. The largest of these is not more than 6 miles long by 2 to 3 broad. They are all flat and somewhat marshy.

This county has few hills of any considerable elevation; its general slope is towards the south and east. The Chalk Downs, which form the continuation of the Chiltern Hills, cross the north-western part of the county. The highest hills in the county are—Langdon Hill (620 feet), Danbury Hill (about 600), High Beech (390), and Tiptree Heath.

The rivers of Essex are the following:—The Thames bounds the county on the south side. Its course, though winding, is on the whole nearly from west to east. The Lea bounds the county on part of its west side. The stream is frequently divided, and flows in several channels, and in some places cuts have been made in order to improve or shorten the navigation. The Stort rises in Hertfordshire, and has a course of 24 miles (of which 10 are navigable) into the Lea. The Roding rises in the western part of the county, and flows past Chipping Ongar, Woodford, Ilford, and Barking into the Thames. Its course is about 36 miles. The Bourne, after a short course of 12 miles, enters the Thames near Dagenham; it joins a pool formed by Dagenham Breach, where the Thames broke through its banks in 1707, and overflowed 1000 acres of rich land. The Ingerburn, which also joins the Thames, is about 12 miles long. The Crouch rises south of Billericay, and flows east by north about 25 miles into the sea. In the tide-way there are many arms; and the various channels by which the river communicates with the sea form the group of Foulness, Wallasea, and the adjacent islands. The Blackwater rises near Saffron Walden, in the north-western part of the county, and flows past Coggeshall, Kelvedon, Witham, and Waldon, into the sea, 46 miles; it receives the Pods Brook and the Chelmer. The Chelmer rises near Debden, and flows about 23 miles to the town of Chelmsford, and 10 more to its junction with the Blackwater. The Colne rises in the north-western part of the county, and flows about 35 miles past Colchester to the sea near Mersey Island. The Roman flows into the Colne. The Stour divides the counties of Essex and Suffolk. Its course is about 50 miles, past Clare and Sudbury, to the sea at Harwich, near which it joins the Orwell. The Cam has a small part of its course in this county.

Many of the above rivers have been improved for navigation by short canals and deepening. The county is well supplied with railway accommodation by the Great Eastern line, which runs right through it, and has several branches.

Geology, Climate, and Agriculture.—A considerable tract in the northern part of the county is occupied by diluvial beds, consisting of loam with fragments of chalk. The coast of the north-east part is covered with the sand or gravel of the upper marine formation, which occupies a considerable part of the counties of Norfolk and Suffolk,

and is locally designated "crag." Fragments of fossil bones washed out of the strata of this formation, in which they had been imbedded, are found on the beach at Walton, but occur in much greater quantities at Harwich. The greater part of the county, including Epping and Hainault or Henhault forests, is occupied by the London clay. The London clay of the cliffs near Harwich contains beds of stratified limestone and several kinds of fossils. The surface of the vegetable mould does not commonly rest immediately on the London clay, but on alluvial beds of rich marl and loam, which often alternate with gravel and sand, and sometimes have a thickness of 30 or 40 feet. The sands and clays of the plastic clay formation skirt the district of the London clay on the north-west. The north-western extremity of the county, about Saffron-Walden, consists of chalk. A subterranean forest underlies the marshes on the banks of the Thames.

The climate of Essex is favourable to vegetation; the sea and the numerous estuaries which bound it on the south and east soften the rigour of winter, and keep up a certain degree of moisture in summer. The same cause, however, produces cold fogs and exhalations in spring and autumn. The soil all along the coast, and 10 or 12 miles inland, is of a very excellent quality, being a friable loam peculiarly adapted to the cultivation of wheat, beans, and oats. The best soils of Essex lie low, and require to be protected from the sea by embankments. Many marshes which formerly produced nothing but herbage, and were subject to inundations, are now converted into arable fields. The soil in the uplands along the coast consists chiefly of good loams, varying in tenacity from a strong clay to a light gravel; most of it is of such a nature as to bear both turnips and beans.

The cold wet clays of Essex used to be farmed on a peculiar system, but since the introduction of under-draining the system is analogous to that of neighbouring counties. After harvest the stubble is generally ploughed in, and before winter the field is laid in narrow ridges, which are formed by two turns of the plough, and sometimes by four turns or two bouts, as they are called. The feeding of oxen in winter is now extensively practised by all good farmers in Essex. Along the Thames the marshes are extensive, and are profitable from the number of horses sent to feed there from London. Besides the common crops usually cultivated, considerable quantities of cole or rapeseed, caraway, coriander, and teasels are raised. Near London the cultivation of the soil partakes more of the garden culture. Vegetables, especially cabbages, are raised in great quantities, and very extensive fields are almost entirely devoted to the growth of potatoes. According to the agricultural statistics published in 1884, there were 1,055,000 acres of land under cultivation in the county in that year—375,000 acres being devoted to corn, 100,000 to green crops, 85,000 to clover and other artificial grasses, and 210,000 being permanent pasture or grass land.

The cows and horses in Essex are chiefly reared in Suffolk, and Scotland supplies the oxen to fatten. Many calves are fattened for the London markets. Essex is not a sheep-breeding county, although many fine lambs are reared; but they are generally bought from the breeders in Wiltshire or Sussex in autumn, and sold fat to the butcher in the succeeding spring. There is no peculiar breed of horses. Essex has been long noted for a superior breed of pigs, which has been produced and improved by crosses with foreign breeds, chiefly the Neapolitan, which has very little hair, and the Chinese.

Divisions, Towns, &c.—Essex is divided into nineteen hundreds and one liberty. The county has one court of quarter sessions, and is divided into eighteen petty and special sessional divisions. It contains 418 civil parishes with parts of three others, and is mostly in the diocese of St. Albans. By the Redistribution Act of 1885, the county returns eight members to Parliament. There are extensive oyster-beds on the coast, and some silk manufactures at Colchester, which is the capital of the county.

History and Antiquities.—In the earliest dawn of the authentic history of our island, Essex was inhabited by the Trinobantes, a powerful tribe whose dominions perhaps extended across the Stort and the Lea into Hertfordshire and Middlesex. Some of the severe encounters between the Romans on one side, and Caractacus and Boadicea on the other, occurred in this county. On its subjugation by the Romans Essex formed part of Flavia Cæsariensis. Several Roman stations were in Essex. Of these the most important was Camulodunum, which is supposed to have been Colchester. Roman antiquities have been dug up in many parts of the county, but especially at Colchester, where urns, pavements, and medals have been found in great abundance, and almost every building shows a greater or less proportion of Roman materials worked up in its walls. Round Colchester are the remains of intrenchments and other military works.

When the Saxons established themselves in Britain, Essex, with some parts of Hertfordshire and Middlesex, constituted a small kingdom, the possessors of which were from their relative situation called the East Saxons. From them the county has derived its present designation. In A.D. 823 Egbert of Wessex despatched his son Ethelwulf and the warlike statesman Ealstan or Alston, bishop of Sherbourne, into Kent and Essex; and these kingdoms, which had sunk into mere dependencies of Mercia, were subdued and probably united under the designation of the kingdom of Kent. When Alfred, after the recovery of his throne, assigned to the piratical Northmen or Danes a settlement in and about East Anglia (A.D. 878), Essex was included in the ceded territory. One or two of the naval conflicts between the ships of Alfred and those of the Danes, who continued to infest the coast, were fought off the Essex shore. There were for nearly two centuries repeated contests in Essex between the Danish colonists and Alfred and his successors.

The history of the county is not marked by any particular event until the civil war between King John and his barons, during which Colchester Castle was besieged. Of the troubled period of the thirteenth, fourteenth, and fifteenth centuries Essex contains several memorials in the encampments, castles, and other ruins which are found in it. Besides Danish and Saxon camps there are remains of many Norman castles, such as those of Colchester, Hedingham, Walden, Ongar, and Raleigh. Of the halls and manor-houses which succeeded the Norman castles, and gave indication of a quieter period, though showing by their massive strength that the nation had not quite settled into peaceful security, may be mentioned Heron Hall, Nether Hall, Tolleshunt-Beckingham Hall, Layer Marney Hall, Belhus or Bellas House, Covet or Covell Hall, Eastbury, Danbury Place, New Hall, and Topping-hoe Hall.

At the Reformation Essex possessed several religious houses, of which there are some remains. There were, at the time of the suppression, seven of the greater monasteries at Barking, St. Osyth, Walden, Waltham, Coggeshall, Colchester, and Stratford Langthorne. Of the smaller priories there are remains at Beleigh, Tiltey, Byckneacre, Latton, Lees, Thoby, Blakemore, and Hatfield Peverel. Many of the churches deserve notice. That of Greenstead, near Ongar, is a very curious edifice, and one of the most ancient in the kingdom; it is traced up to the eleventh century. The nave is entirely composed of wood, the sides being formed of the trunks of large chestnut trees (or oaks) split or sawn asunder, and set upright close to one another. They are let into a wooden sill at the bottom, and into a plate at top, and secured with wooden pins. There is a boarded tower at the west end, but

this does not appear to be so ancient as the nave; also a wooden porch on the south side of the nave. Little Maplestead Church (near Halsted) is a building of great interest, being the latest of the few round churches in the kingdom; it is of pure Decorated character, and its details are plain, but very good.

When the Spaniards were expected to attack England with their Invincible Armada (A.D. 1588) a camp was formed at Tilbury, where a body of more than 18,000 men, under the Earl of Leicester, was posted. Tilbury Fort was then a block-house, which had been built by Henry VIII. to defend the passage of the river; it was at a subsequent period enlarged and made a regular fortification, as it is at present. In the civil war of Charles I. Essex was almost entirely in the interest of the Parliamentarians, and many contests took place within the county.

ESSEX, EARL OF. ROBERT DEVEREUX, second Earl of Essex, was born at Netherwood, in November, 1567. Under the superintendence of Lord Burleigh he was sent to Trinity College, Cambridge, in 1577, and remained there four years. Upon leaving the university he retired to his estate in South Wales, and did not appear at court till 1584. He was immediately taken notice of and patronized by Elizabeth; and upon the death of Leicester, in 1588, he became chief favourite. In 1589 Essex suddenly joined the expedition of Drake and Norris, who had undertaken to restore Antonio to the throne of Portugal, against the queen's wishes, who sent to command his return, but too late. He distinguished himself alike by his gallantry and humanity, and on his return was restored to his place in the queen's favour. In 1591 (a year after he had married the widow of Sir Philip Sydney, whom the queen angrily declared to be unworthy of him), Essex was despatched to assist Henry IV. of France in his resistance to the King of Spain, who sought to obtain possession of Brittany. The expedition was unsuccessful, and his only brother, Walter Devereux, to whom he was greatly attached, was killed.

In 1594 Essex, who had once before come into collision with the Cecils respecting the appointment of the queen's secretary, became a second time at variance with them, in consequence of having asserted the discovery of a plot against the queen's life, which they considered unfounded, but which Essex ultimately established, and the criminal, one Lopez, and his confederates were executed. This opposition was renewed in 1596, on the proposal of Essex for the invasion of Spain. Essex's counsels prevailed, and the expedition, under Lord Howard and Essex, sailed, took and plundered Cadiz, destroyed and captured a number of Spanish ships, and occasioned great loss to the Spanish government; but the expedition was generally deemed a failure. In about two months he returned home, where, though created master of the ordnance himself, he continued to meet with disappointments in his endeavours to obtain official situations for his friends. In July, 1597, Essex as commander-in-chief, with Lord Thomas Howard and Sir Walter Raleigh, sailed against the Spanish fleet. They were driven back to Plymouth by a storm, which did them great damage; and when they again sailed, though they made prizes to the value of about £100,000, they found the Spanish ships in harbour, and could not destroy them. Elizabeth was dissatisfied with the repeated ill success, and Essex retired to Wanstead, angry on account of Howard being made Earl of Nottingham and advanced in rank above him. He was pacified by being appointed hereditary earl marshal, which restored him to his rank. In 1598 a quarrel occurred between the queen and Essex. The queen gave him a box on the ear, and bade him "go and be hanged." Essex was very violent, withdrew from the court, and some months passed before he would make any submission or suffer a reconciliation to be effected. In 1599 he accepted the commission of lord lieutenant of Ireland. His government of that country was inconsiderate and ill-advised; and his opposition to the queen's wishes in the nomination of Lord Southampton to the generalship of the horse, which he was peremptorily ordered to revoke, gave great offence. He at length returned to England without leave in September, for which he was confined to his house, and denied the privileges and authority of his offices. It was not until 26th August, 1600, that he was liberated, and then he was not restored to favour.

Irritated by these events, and trusting to his general popularity, Essex listened to the rash and desperate advice of Cuffe, his secretary, to remove Cecil, Cobham, and Raleigh by force from the queen's councils. This was attempted on Sunday, 8th February, 1601. It was utterly unsuccessful, and after a short defence at Essex House, in the Strand, he was compelled to surrender himself, and with Lord Southampton was committed to the Tower; the rest of the conspirators were lodged in various other prisons. He was tried for treason in Westminster Hall on 19th February, condemned, and executed on the 25th of the same month. It is the great blot on the fame of Lord Bacon, who owed his position entirely to Essex, that he conducted the prosecution on the part of the crown against his patron.

ROBERT DEVEREUX, son of the above, and third Earl of Essex, was born at Essex House in the Strand in 1592. He was sent to Eton by his grandmother, and in 1602 was removed to Merton College, Oxford. He was restored to his hereditary honours in 1603, and three years afterwards was unhappily married to lady Frances Howard, a child not more than thirteen years old. Essex was sent to improve himself abroad, while the bride continued with her mother. It was four years before he returned to claim her; and in a few months his wife, who had become intimate with Carr, afterwards earl of Somerset, instituted proceedings against him for physical inability, and procured a divorce. Essex then retired into the country till 1620, when he accompanied Lord Oxford in the war against Holland. In 1625 he was sent to aid the United Provinces, and his military skill having now attracted attention, the king appointed him vice-admiral of a fleet which was employed in a fruitless expedition against Spain. Essex married a daughter of Sir John Paulet, but he was again unfortunate: he and his wife separated, but a child was born to him, which died at the age of five years. In 1639 Essex, though his inclination to seek popularity among the Presbyterians was evident and undisguised, was employed by the king as lieutenant-general of the troops that were sent against the Covenanters. In 1640 he was one of the twelve peers who signed a petition that a Parliament should be called and an attempt made to settle the difficulties of the state without further bloodshed. He was also one of the commissioners sent to Ripon to treat with the Scots. When the Commons demanded of the king that a guard should be raised in the city of London, it was Essex whom they desired to have placed at its head. Charles declined, and ultimately deprived him of all his offices. Essex now became the chief favourite and leader of the Parliamentary or Presbyterian party. He became Parliamentary general in 1642, and was in consequence proclaimed a traitor by the king. He opposed Charles in person at Edgehill (1642); he also took Reading (1643), entered Gloucester, from which he had driven the king away, surprised Cirencester, and after fighting courageously at the doubtful battle of Newbury, succeeded in covering London. He afterwards marched to Cornwall, where he was encompassed by a superior Royalist force, and was obliged to escape by sea from Fowey. Having once more collected an army, he was placed at its head, but an illness compelled him to quit its command. The Independents soon after succeeded in carrying the "self-denying ordinance," which forbade members of either house of Parliament to hold any command in the army; thus Essex ceased to be a Parliamentary general. It was voted

that for his services he should be raised to the rank of a duke, and be granted a pension of £10,000 a year. He did not, however, live to enjoy these honours, being carried off by a sudden illness in the fifty-fifth year of his age.

ES'SONITE or **CINNAMON-STONE** is a brown transparent variety of garnet; the best specimens are from Ceylon. Almost all true essonites contain myriads of microscopic bubbles.

ESTABLISHED CHURCH, or **CHURCH OF ENGLAND.** In England this title is given to the Protestant Episcopal organization, which has been since Elizabeth's accession (1558) uninterruptedly the state church of the country. Of course the state church was originally what is now called Roman Catholic in doctrine, and for centuries England was subject to the pope. It was not always so, however, for before a single emissary from Rome set foot on English shores, nay before Britain had become England, while yet the Celts and the Romans divided the land, Christianity had superseded Druidism. Of this early period of the British Church, however, we have much less reliable information than could be desired. As early as the year 314 the island seems to have been divided into three ecclesiastical provinces, London, York, and Caerleon (on the Usk in Wales), with three archbishops, each with his complement of bishops. In 544, half a century before St. Augustine came to Kent, and while yet West Britain knew not the English yoke, the British Bishop of Hereford is shown by the records of that town to have attended a synod of the western province under the archbishop at Caerleon.

The English conquest of Britain began in 457, and in the course of about a century and a quarter all but the western side of the island was peopled by this new pagan folk, Saxons to the south-west, Jutes in the south-eastern corner, Angles over the midland east and north. Thus, in the picturesque language of our latest historian, "a wedge of heathendom was thrust into the heart of the great Christian communion, which broke it into two unequal parts. On the one side lay Italy, Spain, and Gaul, whose churches owned obedience to the see of Rome, and on the other the Church of Ireland." In 596 St. Augustine came as a missionary from Gregory, bishop of Rome, to convert the English to Christianity. [See AUGUSTINE, ST.] Efforts were also made soon after, both from Scotland and Ireland, to reconvert northern England to the faith which had been lost. At this time Ireland was the most vigorous of all parts of Christendom for the faith. COLUMBAN founded (as is elsewhere described) churches in Burgundy and the Apennines; ST. GALL has even left his name to one of the Swiss cantons; COLUMBA founded the extraordinary mission station of Iona, to convert the northern Gaels or Scots. It was from hence that the conversion of Northumbrian OSWALD proceeded, after the Kentish church had done its work there and had failed to outlive its first convert, the great EDWIN. [See those articles.] St. Augustine had in vain tried to establish uniformity of doctrine and discipline in the British Church, and with that view held several conferences with the Welsh bishops—six or seven in number—but with little success, as they refused to acknowledge the supremacy of the Bishop of Rome. In the articles on ST. CUTHBERT and ST. CHAD the story of the Scoto-Irish conversion of Northumbria and Mercia is told, and in that on the SYNOD OF WHITBY (664) is narrated the gradual manner in which Rome managed to succeed to the fruits of the labours of these great and good men. The contest at the Synod was, it is true, only nominally over the shape of the tonsure and the date of observing Easter, but King Oswi's decision in favour of Rome on these matters was felt to be a final surrender of freedom on the part of the Irish Christians, and Archbishop Theodore, sent at once by the joyful pope on the news of his victory, had no difficulty in including the north of England in that vast network of parish organization which he proceeded to weave over the ecclesiastically conquered land. As the educated class in the land, the clergy, swiftly rose to political power, the Old English national parliaments, the Witenagemotes, and the county courts or shire courts for the subkingdoms were presided over, the one by king and archbishop, the other by ealdorman and bishop, and afterwards by sheriff and bishop. The power of ST. DUNSTAN has elsewhere been adverted to as a remarkable instance of the early period at which state and church came into close union in England. The collection of Peter's pence (a penny from every hearth) dates from as far back as early in the tenth century in England; and all English archbishops had to go to Rome to make their homage and receive their PALLIUM from the pope's own hands. Another proof of the status of the clergy in the times before the Norman Conquest was the value of a cleric's oath, and of his WERGILD (or death-fine); that of an archbishop was equal to that of an atheling (prince-royal), of a bishop to that of an ealdorman, of a simple priest to those of twenty ceorls.

The establishment of monastic houses, exempt from local ecclesiastical jurisdiction, and subject only and directly to the pope, also greatly increased the Roman influence. William the Conqueror owed so much to the strenuous aid of the pope in his great enterprise that in gratitude he permitted the latter to obtain what had been long striven for, namely, separate ecclesiastical courts. Lanfranc on his side tried to fan this new flame into a formal union of the Church of England with Rome; but William, with that wonderful power of identifying himself with the temper of his new subjects which gained him the epithet of "the Great" from his contemporaries far more than his feats in arms, stoutly refused to put his neck under the papal yoke. To a demand from the pope for homage in 1074 (preferred because William made the bishops do homage to him as their feudal superior just the same as barons) the Conqueror not only answered, "Fealty I have never promised, nor do I find that my predecessors did it to yours;" but he went further—he issued a Constitution or edict: (1), That no papal legate, or papal bull, or decree of a church council be received in England without the king's sanction; (2), that no baron be excommunicated without the king's leave. The quarrel of William Rufus with Archbishop ANSELM, and its inheritance by Henry I., ending in leaving the question of the royal supremacy an open one by a compromise, is elsewhere recounted. The pope was to invest the archbishops of England with ring and crozier as betokening his spiritual supremacy, while the king received temporal homage for the church possessions (1106). Shortly after Henry yielded so far as to allow an ecclesiastical appeal to the pope. Under Henry II. the long struggle which began with St. Dunstan and Edwy, and continued with St. Anselm and Henry Beauclerc, came for a time to an end with St. Thomas A'Becket and Henry of Anjou. At first the king was the gainer by the thoroughly national and wise Constitutions of Clarendon, clearly defining the state supremacy in state matters; but the unhappy murder of A'Becket in 1170 gave a remorseful king and people over to the control of the most powerful ecclesiastical organization that the world has ever yet seen. Still, this elevation of the clergy was not without its good results, for they joined heartily with the baronage in resisting the arbitrary exactions of Richard and John. John, to end the strife, named a creature of his own as the new Archbishop of Canterbury (1205); the Canterbury monks elected their sub-prior, and a dead lock ensued. The pope intervened, and nominated and consecrated Stephen Langton in 1207. John expelled the monks. The pope put all England under an interdict. John confiscated all the possessions of the clergy. The pope excommunicated him (1209), deposed him (1212), and

commanded the King of France to eject him. The people hated John for his many vices and cruelties, and gave him no support; he was forced in the end to the bitter submission of handing his crown as forfeit into the hands of the papal legate Pandulph, and receiving it back for the annual subsidy of 1000 marks and the acknowledgment of the pope's feudal supremacy. The immediate result was the entire separation of England from the king, and the signature of MAGNA CARTA, which begins by declaring the church to be free. Henry III. continued his father's submission to the church, but the great Edward did not share the weakness of his father. The Statute of Mortmain (1279) struck at the root of the terrible power it could exercise over the deathbed, and in 1285 followed the famous writ, *Circumspecte agatis*, confining the jurisdiction of the ecclesiastical courts. Pope Boniface VIII. forbade the clergy to pay taxes; Edward, who unlike John had the nation at his back, outlawed the clergy. He would have gone further, and already had laid hands on the estates of Canterbury, in his swift way, had not the priests, who knew their man better than Boniface, hurriedly discovered that it would not be against the pope's bull if they were to set aside a fifth part of their income to make a fund which might be drawn on if there were a great necessity of state. Edward passed by the subterfuge, took the money, and restored the archbishop from the humble parish church where he lived upon the voluntary offerings of his flock to his full former state. Under Edward II. the popes gained a little, but the Parliaments of Edward III. defended the nationality of the church by the statute of provisors (1351), which as afterwards extended excluded all papal patronage whatever from the realm; and by the famous statute of præmunire (1353), forbidding any interference of any foreign court, whether of a pope or a king, in the affairs of England under the heaviest penalties to the bearer of such message of interference, of which forfeiture of all goods and perpetual imprisonment formed the leading features. Regardless of the growing anti-papal sentiment Pope Urban V. demanded, in 1365, the arrears of tribute which had long been due according to the compact of King John. His answer was short. The Parliament simply said that the king had done what he had done without the authority of the nation, and consequently the promise was valueless.

The first deliberate attempt at freedom on the part of the church itself followed under WYCLIF, the great Lollard heresiarch, and is elsewhere narrated in full. Richard II. endeavoured, as a Catholic, to check the heresy, while at the same time, as an English king, re-enacting his grandfather's statutes of provisors and præmunire. But under Henry IV., whose weak title the church firmly supported, persecution began, and our first penal religious statute (*De heretico comburendo*, for burning heretics) defaces the statute-book for 1401. The downfall of national liberty in the terrible period of the Wars of the Roses, which sapped the life of the country, and the slow recovery of vigour, though not indeed of freedom, under the first Tudor, had left the church pretty much alone. But the blaze of heresy under the hero of Protestantism, the monk Martin Luther, set England, now once more full of life, aflame too. Henry VIII. never joined the Protestant movement; indeed he wrote against Luther, and received from the grateful pope the title *Fidei Defensor* (the faith's defender), which in defiance of all right or reason is to be seen even to this day in the style of our sovereigns. But the Pope Clement, in fear of the Emperor Charles V., allowed Henry's divorce suit from Catharine of Aragon (who was the emperor's aunt) to linger on year by year without a settlement, until finally the king seized the opportunity of the national temper to break with the pope altogether. The Reformation Parliament met in 1529, and during its seven years' existence first regulated the church discipline, then declared appeals to Rome forbidden (1532), and finally in 1534 abolished the payment of annates (firstfruits and tenths) to the pope, vesting them in the sovereign, and declaring Henry and his successors *supreme head of the Church of England on earth*. The annates were received by our kings up till Anne, who made them part of the well-known Queen Anne's bounty for the good of the clergy. [See ANNATES.] The English Church returned to its national feeling, and welcomed rather than opposed the destruction of those monasteries which formed the hotbeds of papal intrigue (1536–39). But the Law of the Six Articles (1539) at the same time showed Henry to be no friend to the Lutherans. It imposed the penalty of death by burning for denial of the doctrine of (1) Transubstantiation, and forfeiture (followed by death for a second offence) for denying the doctrines of (2) communion in one kind, (3) celibacy of the clergy, (4) vows of chastity, (5) private masses, and (6) auricular confession. Protestants and Catholics perished at the same stake, the one for denying Catholic dogmas, the other for denying the king's supremacy. Henry yielded to the demands for an English Bible in the churches, &c., but made a refusal to attend mass felony. Even at the fall of Cromwell, whose energy had upheld the Protestants against his master's attachment to the older faith, Norfolk and the Catholic reactionaries felt it imperatively necessary to publish an English Litany to prevent the noisy reading of the English Bible during mass by the younger converts. This litany formed the basis of our Book of Common Prayer. Finally, Henry yielded to the inevitable, agreed to the conversion of the mass into an English Communion Service by Archbishop Cranmer, and reduced the grave penalties of the Six Articles.

Edward VI. was the first Protestant king. Cranmer, now thoroughly Protestant, gave full play in the new reign to his convictions. The Law of the Six Articles was abolished, images were removed from all churches by royal injunction, marriage of priests declared lawful, the communion administered in both kinds, the altars thrown down and wooden tables substituted for them, the service held altogether in English, and made up of translations from the old Missal and Breviary with a few additions, and a catechism was drawn up to precise the new doctrines. This Catechism and this Prayer Book are with slight alterations what we now have; and Edward's forty-two articles, reduced by Elizabeth to thirty-nine, rule the Church of England to this day. A tolerably stringent Act of Uniformity was passed in 1549, and reinforced in 1552. Indeed an ecclesiastical code was preparing all during Edward's reign as a substitute for the canon law of Rome, which would have made the new religious doctrines compulsory. The wisdom of Elizabeth allowed this to drop. The great queen saw what a monstrous engine of oppression lay therein. England had, later, a taste of such a code indeed (though unwritten) under the Puritans, and the revulsion of its hate carried it into the foul quagmire of the Restoration. On the death of Edward VI., Mary, a fervent Catholic, daughter of Henry VIII. by Queen Catharine his first wife, ascended the throne, and endeavoured by every means in her power, even including bitter persecution, to make the country again Roman Catholic, but on the succession of her half-sister, Elizabeth (the daughter of Henry by Anne Boleyn), the reformed faith was re-established, and in a short time things in the English Church were restored to the condition in which they had been in the year previous to the death of Edward VI. In 1559 the Act of Supremacy was passed with penalties of *præmunire*, and also an Act of Uniformity of Worship, making the Prayer Book of Edward VI. compulsory, and enforcing attendance at church under penalties. In 1563 the forty-two articles of religion which had been agreed to by that monarch were examined and assented to by the queen under the title of the "Thirty-nine Articles." They were again revised, and

some slight alterations made in them, in 1571, since which they have remained unaltered. In 1562, 1571, 1580, 1584, 1585, and 1593 Elizabeth passed severe Acts against the Catholics, whom she persecuted in fully as horrible a manner as her sister had done the Protestants before her. Pius V. deposed her in 1570, and Foxe's "Book of Martyrs" was the Protestant reply. Spain sent the Armada in 1588, and it was met so that never has any power seriously attempted to attack our shores since then. On the other hand Elizabeth both feared and hated the Puritans, and in 1567 the "Advertisements" of Archbishop Parker were published. Elizabeth was a mistress of tongue-fence, and in these advertisements (in the archbishop's not the queen's name, be it observed, for the better ease of repudiation if need were) she so cautiously defined the minimum of ritual which was demanded of the Puritans that the opposite party in our own day have found their evasions and contradictions a very rock of refuge. The Puritans felt the queen's hand almost, if not quite, as heavily as the Catholics, and a fanatical hatred was begotten against the church which would have astounded Elizabeth, true child of the Renaissance, if she could have perceived it. During the latter part of the reign of Elizabeth and throughout that of her successor, James, efforts were made to bring the articles more into conformity with the Calvinistic theology, but without any ultimate effect. In 1628 King Charles issued his "Declaration concerning Religion," and required that the Thirty-nine Articles should be adhered to as the bond of union and standard of doctrine; he ordered that those doctrines be received and held in their "ordinary sense," "in the plain and full meaning thereof," "in the literal and grammatical sense." The Calvinists complained bitterly that this was a restraint upon them, and a prohibition of their known construction of the articles. Matters, however, remained without any material alteration during his reign; and after a season of triumph of Puritanism under the Commonwealth the church was still found apparently, under Charles II., in its former position. It was, however, soon clearly seen that there was such a radical difference between the English Church and dissenters generally, that no union could possibly be effected between them; and accordingly, after the Corporation Act of 1661 and the Act of Uniformity of 1662 (the third of such Acts), no less than 2000 clergymen left the church rather than conform to her articles and her Book of Common Prayer. In 1664 the Conventicle Act forbade religious assemblies as contrary to the Act of Uniformity. Again in 1665 by the "Five Mile Act" dissenting clergy were banished 5 miles from any town. The king, finding these Acts against the Puritans told with equal force against the Catholics (of whom he was at heart one), abrogated them by the Declaration of Indulgence, 1672, notable as freeing Bunyan from Bedford prison. The country, alarmed by the confirmation of the king's change of religion, insisted on the passing of the stringent Test Act, 1673, refusing office to all who did not take the communion according to the Church Service. In 1678 Catholics, as such, were excluded from Parliament. Charles II. was succeeded by his brother, James II., a Roman Catholic. He sought first to secure for his own faith a free toleration in England, hoping, it was supposed, to ultimately bring the English Church again into conformity with that of Rome. The illegal Declaration of Indulgence by which he sought to do this was one of the causes of his ejectment from the throne. A portion of the bishops and clergy, however, who had been foremost to resist his efforts to Romanize the church, stood by him when dissenters and others sought to place William of Orange on the throne in his stead. They considered themselves bound in conscience to preserve the purity of the church, and equally bound by their oath of allegiance to be faithful to his inherited right to the throne. Hence they refused the oath of allegiance to William III., and became known in history as *non-jurors*. This state of things caused the non-jurors or high-churchmen to be no favourites with William, and his advisers and friends—a feeling which has had its effect ever since, for during his reign the Toleration Act (1689) was passed, mitigating the enactments against all sects except Roman Catholics and Unitarians. Except for the persistent efforts to relieve the Catholics from the pressure of the Corporation and Test Acts otherwise than by an annual Act of Indemnity, efforts covering 1778, 1801, 1805, 1810, 1815, and 1819, a state of rest in religious matters ensued—broken by the Wesleyan and Whitefield movements, and the rise of the Evangelical school. In 1813 the Act of Parliament which imposed the penalty of imprisonment on all who denied the doctrine of the Trinity was repealed, and in 1828 the Test Act was also repealed. In the following year the Roman Catholic Relief Act, or as it is usually called, the Catholic Emancipation Act, was passed, but a provision was made therein for the supposed security of the Established Church. Until 1866 the oath taken by Roman Catholics in the Houses of Lords and Commons therefore contained the following pledge:—"I do hereby disclaim, disavow, and solemnly abjure any intention to subvert the present Church Establishment, as settled by law within this realm." This was sworn to "on the true faith of a Christian." These words, which excluded Jews, Mohammedans, and all heretics, were long objected to, and in 1866 an Act was passed substituting a uniform oath to be taken by members of Parliament of every creed. But as this last version of the oath concludes with the asseveration "So help me God," Quakers and some few others are allowed to affirm at their option, as conscientiously prevented from taking an oath.

The only offices from which Roman Catholics are excluded are those of regent, lord high chancellor, the lord lieutenant of Ireland, and high commissioner to the General Assembly of the Church of Scotland. Of late years many other Acts have been passed which have entirely departed from the old principle of requiring uniformity of religious faith. Dissenters may now be married in their own places of worship and according to the rites of their sect (provided only that the marriage formula dictated by the state be part of the service, and that the registrar be within hearing), or the contract can even be made by a merely civil ceremony. Baptism at the parish church is now unnecessary for civil purposes, and a lay department has been established for the registration of births, marriages, and deaths, to which entries in parish church registers have also to be communicated. The king or queen of England must, of course, be a member of the Established Church, and may not marry a Roman Catholic; but with the exceptions noticed above in the case of the Roman Catholics, nearly every civil office in the United Kingdom is now open to all her Majesty's subjects, of whatever persuasion.

The course adopted by the party who began in 1830 as high-churchmen or English Catholics to revive Roman Catholic practices (though not, of course, denying the queen's supremacy), caused the passing of the Public Worship Regulation Act, which came into force on 1st July, 1875. The first instance in which the Act was invoked was that known as the "Folkestone Ritual case," in which the practices of a well-known high-church clergyman were, early in 1876, pronounced unlawful and forbidden. The high-church party, however, did not acknowledge the decisions of the court established by the Act as binding, and continued their struggle for a return to the old forms, though it is self-evident that anything like systematic defiance of the authority of the state by the clergy of a state church can only have the effect of ultimately separating the church from the state.

The Established Church of England claims to be the legitimate heir and representative of the church founded in

Britain before the English conquest. The English assert that they had a perfect right to reject the papal authority, inasmuch as it was not given by any direct divine institution or appointment witnessed or testified to in the Holy Scriptures, and that its claims from the first were in contravention of the most sacred canons of the universal church. Her members, of course, deny that at the Reformation there was any real schism between her and the true Catholic church, and claim a direct succession of ordination from the apostles, since Cranmer was in every sense an archbishop under the old faith. Doctrinally the Church of England claims to be based on the Holy Scriptures, as interpreted in the apostles' and other ancient creeds of the church that have been universally received, and to have kept herself aloof from all modern systems of faith, whether of Calvin, Luther, or Arminius; leaving her members free to enjoy their own opinions on all points not represented in Scripture as necessary to salvation, and refusing to be narrowed down to any other creed or creeds than those of the apostles and primitive church. She claims also to have retained all that is essential to church organization in her episcopate, and in her liturgy to have a wise and judicious manual of doctrine and devotion. The characteristic tenets of the Established Church of England, besides the doctrines of the Trinity and redemption through the sacrifice of Christ, are a regeneration or spiritual birth in baptism, in which the baptized becomes a member of the church; and a growth in grace by the use of the sacraments and ministrations of the church duly administered and received, made efficacious by the word of divine truth and the gracious influences of the Holy Ghost, freely given to all who duly seek and faithfully use them. The condition of man since the fall is such that he can do nothing pleasing to God without preventing grace; good works, though pleasing to Heaven, have no power to put away sin; works of supererogation, over and above God's commandments, cannot be taught without arrogance and impiety; the church has power to decree rites or ceremonies, and to decide matters of faith; the Roman Catholic doctrines of purgatory, invocation of saints, and respect to relics and images, are rejected; clergymen are allowed to marry; and communion is to be given in both kinds. The number of sacraments is two—Baptism and the Lord's Supper. The clergy of the Established Church constitute a distinct order. [See BENEFICE, CLERGY, BISHOP.] No person can be ordained to holy orders who does not subscribe to the Liturgy and Thirty-nine Articles, which latter comprehend assent to the doctrine of the king or queen's supremacy. The Church of England is divided into two provinces, Canterbury and York—with an archbishop in each, and under them thirty-four bishops. The archbishops and twenty-four of the bishops have seats in the House of Lords. Besides these there are a large number of bishops in the English colonial dependencies, and a number of clergy, amounting in all, at home and in the colonies, to about 24,000. For the management of ecclesiastical affairs, the provinces of Canterbury and York have each a council, or convocation, consisting of the bishops, archdeacons, and deans in person, and of a certain number of proctors as representatives of the inferior clergy, summoned by the respective archbishops, in pursuance of the queen's mandate. When assembled they must also have the queen's license before they can deliberate, as well as the sanction of the crown to their resolutions before they are binding on the clergy. In the province of Canterbury convocation forms two houses; the archbishops and bishops sitting in the Upper House, and the inferior clergy in the Lower. In the province of York all sit together in one.

England is distributed into 200 extra-parochial places, and about 18,500 parishes. In every parish there is a parish church presided over by a rector or vicar. During his life he has (unless the anomalous personage of a lay rector or lay impropriator has acquired or inherited them—he being usually devoid of any obligation to provide spiritual teaching, or do anything but collect tithes) the freehold of the parsonage, the glebe lands, the tithes, and other dues—arising principally from certain customary fees for the performances of marriages, baptisms, and interments. Besides the right of presentation to livings pertaining to the queen, the lord chancellor, the Prince of Wales, the higher clergy, the chapters, and the universities, there are about 3850 lords, gentlemen, and gentlewomen in the enjoyment of private patronage. No information regarding the number of persons belonging to the Established Church in England is given in the official census. Her income cannot be ascertained with exactness, but is certainly not far from £8,000,000. Parliament may alter the distribution of the property of the church, as it did some years since, by uniting and suppressing bishoprics, creating new sees, abolishing sinecures, and disposing of some parts of the revenues of the church for other church purposes; but it has not sanctioned the diversion of the revenues of the church to other than ecclesiastical uses since the time of Henry VIII.

Until the passing of the University Tests Abolition Act in 1871, the constitution of the Universities of Oxford and Cambridge excluded persons who did not belong to the Established Church from a full participation in their advantages.

IRISH EPISCOPAL CHURCH.—The fifth article of the Act for the Union of Great Britain and Ireland (1800), enacted, "That the churches of England and Ireland, as now by law established, be united into one Protestant Episcopal Church, to be called the United Church of England and Ireland." The proportion of Roman Catholics in Ireland to members of the Established Church in 1834 was 100 to 13·25; in 1861, 100 to 15·35. The Protestant Establishment having been thus for many years the church of but about one-seventh part of the population, and this fact having for a very long period caused much ill-feeling and dissatisfaction, an Act for the Disestablishment of the Irish Church was at length passed, which received the royal assent 26th July, 1869.

The principle of the state maintaining an exclusive system of education, in accordance with the principles and doctrines of the Established Church, has been abandoned both in England and Ireland. The parliamentary grants for education are enjoyed by dissenters as well as churchmen. Parliament formerly annually voted funds for the education, at Maynooth College, of Roman Catholic priests; but when the Irish Church was disestablished this annual sum was commuted into one payment.

The ESTABLISHED CHURCH OF SCOTLAND differs in many and important respects from the Church of England. It was first established at the Scottish Reformation in 1650, by the influence of John Knox and his associates, on the pattern of that established by Calvin at Geneva. It was superseded by an Episcopal Church under the restored Stuarts in 1662; but in 1690 the Presbyterian Church regained its position after the coming of William III., and at the union of the kingdoms of England and Scotland, in 1707, a special statute was passed providing that the Protestant religion and Presbyterian church government in the latter country should continue without alteration. An Act passed by the British Parliament in 1712, restoring to patrons in Scotland the right of presentation to benefices caused much dissatisfaction, and led to several secessions from the National Church at subsequent times; but patronage was finally abolished in Scotland in 1874, by the 37 & 38 Vict. c. 82, which provides that the right of appointing and electing ministers to vacant parishes shall vest in the congregations, subject to regulations to be framed by the General Assembly. [For the detailed history of the Scottish Church see SCOTLAND.]

The Church of Scotland is a perfect democracy, all the

members being equal, and none of them having power or preeminence of any kind over another. Its local affairs are managed by district presbyteries, and the chief governing and legislative power is vested in a General Assembly for the whole of Scotland, which consists partly of clerical and partly of lay members, chosen by the different parishes, burghs, and universities, and which meets annually in May for ten days. The assembly is honoured during its sittings with the presence of the representative of the sovereign, at present the Earl of Aberdeen, who bears the title of Lord High Commissioner. He cannot, however, interfere in any way with its proceedings. All matters brought before the assembly are decided, after debate, by vote. The stipends of the clergy are derived from the wreck of the tithes and other property that belonged to the Roman Catholic Church, which was seized upon at the Reformation by the nobility and gentry. In 1812 an Act was passed to raise at the public expense the incomes of such clergymen as had less than £150 a year, exclusive of glebes and houses, to that sum. The number of parishes in Scotland is 1290, and of unendowed churches and preaching and mission stations, 282. The average income of the clergy is about £200 per annum, over and above their glebes and manses. The dissenters from the Church of Scotland are very numerous, being estimated at from one-half to two-thirds of the entire population. The largest body is the FREE CHURCH, and the next the UNITED PRESBYTERIAN CHURCH, recently formed from the amalgamation of several bodies of seceders, some dating back as far as 1741. In doctrine the three churches are identical—only differing on the question of relation to the state. There is an Episcopal Church which includes a large number of the nobility and gentry. In 1884 its clergy numbered about 300, with six bishops.

At the Reformation nearly every Protestant state established a church, conformity to the tenets of which it enforced, not only upon those who, as ministers, were henceforth to enjoy the property which in Roman Catholic times had been devoted to the spiritual interests of the community, but very often on its own civil servants and advisers. The benefit of the arrangement was, that to a greater or less extent the means which the community had set apart for its spiritual improvement were protected from the spoliation of private individuals. The general arguments in favour of established churches are, that it is the duty of the state to provide for the religious instruction of the whole body of the people, as most essential to their moral welfare, and so to the general prosperity of the community. It is also argued that civil rulers, or the people associated in a free state, are under a moral obligation of the highest kind to publicly acknowledge God and provide for the decent celebration of his worship.

ESTATE. An estate signifies that title or interest which a man has in lands, tenements, hereditaments, or other property. It is either real estate, which comprises lands, tenements, and hereditaments held or enjoyed for an estate of freehold; or personal estate, which comprises interests for terms of years in lands, tenements, and hereditaments and property of every other description. Personal estate [see CHATTELS] goes to the executors, and is liable for payment of debts before real estate.

This is the legal signification of estate, which is not a piece of land or other property, but signifies the relationship of ownership between a man and property. The word was also used in former times to signify men's station (status) or condition in life. It was also used, and is still sometimes used, to signify a class or order in a state.

All real estates not being of copyhold tenure [see COPYHOLD], or what are called customary freeholds, are either of freehold or less than freehold. Freeholds are freeholds of inheritance or freeholds not of inheritance. Freeholds of inheritance are either inheritances absolute, called fee simple, or inheritances limited, called qualified or base fees, or fees conditional. A freehold of inheritance absolute or fee simple is the largest estate which a man can have: the owner may freely dispose of it to whom he pleases by deed or by will, and if he dies without making any disposition it descends to his heir.

A freehold not of inheritance is an estate which the owner has for his own life only, or the life of some other person, or until the happening of some uncertain event.

Of estates less than freehold there are three kinds—estates for years, commonly called leaseholds, at will, and by sufferance. An estate at will arises where a man lets land to another expressly at the will of both parties, or without limiting any certain estate; either party may put an end to the tenancy when he pleases. An estate by sufferance arises where a tenant, who had entered by lawful title, continues in possession after his interest has determined.

Estates are also legal or equitable. It is a legal estate when the owner is in the actual seisin or possession, and also entitled to the beneficial interest himself, or in trust for some other person. An equitable estate is when some other person, not the person who is the actual and legal owner, is entitled to the beneficial interest of the property of which that other is in possession. The power of the beneficial owner over his equitable estate is as complete as if he were possessed of a legal estate.

ES'TE, HOUSE OF, one of the oldest historical families of modern Europe, and the oldest among those which have retained sovereign power to the present century, the house of Savoy perhaps excepted. Some chronologists have endeavoured to trace back the genealogy of the house of Este to the fifth century of our era; but the more probable origin is to one of the Longobard feudatories, who held Tuscany under Charlemagne. The family has undoubtedly held a distinguished rank in Italy from that time; and in 1070 one of them, Welf IV., was made Duke of Bavaria, and from him the line of Brunswick and Hanover, containing the present royal family of England, known also by the name of Este-Guelphs, is descended. From the main line, which held the fief of Este, descended the marquises of Este, who became afterwards dukes of Ferrara, and ultimately of Modena and Reggio. All took a prominent part in the political affairs of Italy; but perhaps the one most generally known is Alfonso II., the patron at one time of the poet Tasso, whom he subsequently imprisoned in the madhouse of Santa Anna, on suspicion of an attachment to his sister Eleonora. In 1598, on the failure of the direct male line, Ferrara was taken possession of by Pope Clement VIII. The family continued in possession of Modena and Reggio till the subjugation of Italy by Bonaparte, when Ercole Rinaldo, the last duke, was driven away, and died in the Austrian states in 1803. His grandson was restored by the peace of Paris in 1814 to the duchy of Modena. During the disturbances in Italy in 1847, the Duke of Modena (son of the above) was chased from his capital and subsequently abdicated. By a decree of 19th May, 1848, Massa-Carrara and Garfagnana were united to the grand-duchy of Tuscany. In 1859 the Tuscans expelled their sovereigns, and declared their country annexed to the newly-united kingdom of Italy.

ES'TE (the Roman *Ateste*), a town of Italy, in the province and 17 miles S.S.W. of Padua. It is an old town, beautifully situated on the southern slopes of the Euganean Hills, and is well built in the antique Romanesque style, many of the houses being supported on arches. Its chief buildings are—the old Romanesque church of St. Martin, with a leaning tower like those of Bologna and Pisa, and a fine old castle of the Este family, which overlooks the town. This family came originally from Tuscany and first becomes noted in the person of Azzo I., under the Emperor Henry III. (1039–56.) This monarch, under whom the empire attained to the meridian of its

power, bestowed the duchy of Bavaria on Welf, son of Azzo, on the proscription of Otho the former duke. From this family the royal family of England is lineally descended. [See previous article.] The town of Este is now a prosperous place, with manufactures of silk, linen, and earthenware. Population, 10,475.

ESTEL'LA, a town of Spain, in Navarre, 20 miles S.W. of Pampeluna, agreeably situated on the left bank of the river Ega, at its junction with the Amescua. It has some manufactures of woollen cloths, oil, and brandy. Population, 6000. Estella was long the headquarters of Don Carlos, who was proclaimed here in 1833, and it was used for the same purpose in 1873. The town occupies one of the strongest strategic positions in Europe, being situated at the apex of a triangular valley which has the sea for its base and two ranges of high rocky mountains for its sides. This valley, known as the Amescoas, has an area of about 200 square miles, is exceedingly rich and fertile, and is, from its natural conformation, really an immensely strong fortress on a gigantic scale, capable of being defended by a few men, and of sustaining an army year after year.

ES'THER, BOOK OF, a canonical and historical book of the Old Testament, of unknown date and authorship, placed after that of Nehemiah, but coming chronologically between the sixth and seventh chapters of Ezra. It gives an account of a remarkable deliverance of the Jews in Persia in the time of a king Ahasuerus, accomplished by his queen, Esther, a Jewess. The king is conjectured to have been Artaxerxes; though some see in him a stronger resemblance to the effeminate Xerxes, while others identify him with Darius Hystaspes, and fix its date about 485 B.C. By the Jews the book has been always considered as one of the most precious of their sacred scriptures, and as a perfectly authentic history of real events which took place about 519 B.C. They call it Megillah Esther, that is, the volume of Esther, or simply The Volume, and hold it in the highest estimation; believing that whatever destruction may happen to the other scriptures, Esther and the Pentateuch will always be preserved by a particular providence. By many modern critics it is contended that the book of Esther is only an historical romance; but the great fact that the Jews still celebrate, and have immemorially celebrated, a festival (the feast of *Purim*) designed to perpetuate the memory of the events which the book records, and for the origin of which no other account exists, has been urged by Eichhorn and others as affording sufficient proof of its authenticity. The language of the book is of a period later than that of Ezra and Nehemiah, and the Septuagint Version contains many passages not in the Hebrew, but which appear to have been added by the Alexandrian Jews. These interpolations, removed from their proper positions and placed together, are given in the Apocrypha under the title of "the rest of the chapters of the Book of Esther." Unlike the rest of the books of the Old Testament the book of Esther contains no trace of theology. There is no reference either to the practice of prayer, the offering of sacrifice, to the temple or the holy city, and notwithstanding the peculiar character of the story there is no allusion to Divine providence, and the name of God is not once mentioned.

ESTHO'NIA, a government of European Russia, on the coast of the Baltic, immediately to the south of the Gulf of Finland. It was added to the Russian Empire by the treaty of Nystadt in 1721. Its principal town is REVEL. The area of the government is 7817 square miles, and its population 340,000. The Esthonian language is of the Turanian or "Scythian" family, whereof Turkish is the best known and most prominent type. The Esthonian is nearly related to the Finnish, and more distantly to the Magyar, belonging indeed to the Finno-Hungarian or Ugrian group, now entirely European in position.

ESTOP'PEL, an impediment or bar to the exercise of a right, which impediment arises from a man's own act, or the act of some person through whom he claims. There are three kinds of estoppel. 1, *By matter of record*, as letters patent, pleading, &c. Thus, in an action against a patentee by his assignee, the patentee is estopped from pleading that the patent is invalid. 2, *By matter of writing*, as by deed, &c., parties and privies are estopped from alleging anything contrary to the deed. 3, *By matter in pais* (in the country), that is, transactions between the parties not evidenced by record or writing, as livery, entry, acceptance of rent, &c. Thus after acceptance of rent a landlord cannot treat his lessee as a trespasser.

The analogous Scotch term is "personal exception" or "bar," and denotes any personal impediment by which a litigant is debarred from resorting to a plea otherwise available.

ESTO'VERS. Spelman in his Law Glossary says that this word is derived from the French *étoffe*, and that from *étoffer*, which is to supply with necessaries, and is of the same signification as the Saxon word *bote*. The word signifies the power which the owner of an estate for life, as well as a tenant for years (in the absence of any stipulation to the contrary) possesses of taking a reasonable and necessary supply of wood from the estate for the use or furniture of his house or farm, and this, according to the use to which it was applied, was called house bote, plough bote, cart bote, or hedge bote. *House bote* is a sufficient allowance of wood to build or repair the house, or to burn in it, which latter is also sometimes called *fire bote*; *plough bote* or *cart bote* is the wood employed in making or repairing all instruments of husbandry, as carts, ploughs, harrows, &c.; *hedge bote* or *hay bote*, for repairing hedges, fences, pales, stiles, and gates, and to secure inclosures.

If a tenant takes more than is needed for these purposes he may be punished for waste, as if he cuts down wood to burn when he has sufficient dead wood upon the estate; and a tenant, although he may cut down and take sufficient wood to repair pales and fences as he found them, cannot do so to make new ones.

In Scotch law *estoverium* had much the same meaning as the English corresponding term. It is seldom used since the abolition of the military tenures, but the right is still recognized in the case of life-renters.

ESTRAY', any valuable tame animals found wandering at large within any manor or lordship, and whose owner is unknown. Having been impounded, they become, if not claimed in a year and a day, the absolute property of the king, as lord paramount of the soil, though generally the lord of the manor or liberty is the special grantee of the crown. The king or the lord does not acquire the property in the estray until the full expiration of a year and a day, which runs from the first proclamation, and not from the seizure; therefore if it escapes before the time to another manor, he cannot reclaim it.

The king or the lord is bound to take care of the estray, and find it in provision. The owner, if he claims within the time allowed, must pay the charges of finding, keeping, and proclaiming it.

The analogous term in Scotch law is "stray" or "waif;" in practice the finder sells after advertisement, or where of considerable value, under warrant of a magistrate. As in England, strays unclaimed within year and day belong to the crown, unless the proprietor of the ground have an express grant of strays in his charter. In most burghs the police Acts make special provisions for the disposal of strays and waifs.

ESTREAT' (from the Latin word *extractum*) is a true copy or note on the rolls of a court of some original writing or record, especially of fines and amercements which are to be levied by a bailiff or other officer. In all cases of felony or misdemeanour where persons bound by recognizance

either to appear themselves or for the attendance of any witness on trials of felonies or misdemeanours, neglect to do so, the recognizance becomes forfeited; an officer of the court, whose duty it is, at the end of the assize or session prepares a list of the defaulters, and, when the same has been approved by the judge presiding, the fine or forfeiture mentioned in the recognizance is said to be estreated or certified into the Exchequer, and process is awarded for its recovery. These fines, when levied, are paid into the Treasury, or the lords of the Treasury may, if they think fit, previously to the issuing of the process, stay the execution and remit the fine.

ESTREMADU'RA, an old province of Spain, now represented by the provinces of Caceres and Badajoz. It was bounded N. by the province of Salamanca, E. by New Castile, S. by Andalusia, and W. by Portugal. Cortes, the conqueror of Mexico, the two Pizarros, the Almagros, and other adventurers, were natives of Estremadura. It anciently formed part of the kingdom of Leon.

ESTREMADU'RA, a province of Portugal, is bounded N. by Beira, E. by Beira and partly by Alemtejo, S. by Alemtejo, and W. by the Atlantic Ocean. The greatest length of the province from N. to S. is about 140 miles, and its greatest breadth from E. to W. is about 85 miles. The area is stated to be about 7000 square miles, and the population in 1883 was 951,545. The Serra de Estrella, which crosses the province of Beira, sends off a branch to the south-west, which enters Estremadura east of Pombal, and runs S.W. through the province under the names of Serra de Louzao, Serra de Alberdos, Monte Junto, and Serra de Baragueda. The Serra de Baragueda stretches to near Torres Vedras, and there meets the ridge which spreads from the Tagus to the sea across the peninsula in which Lisbon is situated. This latter ridge, which is separated from the former by a deep narrow ravine extending from Torres Vedras towards Sobral, furnished Wellington in 1810 with a position of defence against the French under Marshal Massena. Serra de Estrella divides the waters which flow into the Tagus from those that run direct into the ocean. The chief river is the Tagus, which divides the province into two nearly equal parts, and falls into the sea below Lisbon.

That part of Estremadura which lies N.W. of the central ridge and between it and the sea is mostly flat and sandy towards the coast, and either barren or covered with forests of pines. The country which lies to the S.E. of the ridge sloping towards the Tagus is finer and better cultivated, especially the plains about Thomar and Santarem, which are very fertile, and abound with olive and other fruit trees and fine pasture grounds. The country about Cartaxo produces much wine, but the best part of the whole province is that which lies to the S. of Torres Vedras towards Lisbon. Between various ranges of hills are delightful valleys, covered with villages, convents, and country-seats, and with gardens, orchards, and vineyards remarkably well cultivated.

The southernmost part of Estremadura, which lies on the left bank of the Tagus, is not so fertile as that on the right bank, being mostly low and flat, and in some places unhealthy. A range of hills, which is a continuation of the Serra de Portalegre in Alemtejo, enters the east of the province, and terminates in the peninsula of Almada, opposite to Lisbon. The southern part of the province, which is nearly inclosed by Alemtejo, the sea, and the Tagus, forms the comarca of Setubal. The other district, on the left bank of the Tagus, and inclosed between it and Alemtejo, contains the territories of Chamusca, Almeirim, and Salvaterra, which are included in the comarcas of Santarem and Alemquer.

The climate, with the exception mentioned, is generally healthy. The westerly winds, which find an opening along the wide valley of the Tagus, refresh the air. The principal products of the country are wine, oil, maize, fruits of every sort, and cattle. Wheat and oats are also raised, but in no great quantity.

ES'TUARY is an inlet, creek, arm of the sea, or frith. The term is usually applied to those waterways penetrating into the land which are formed at the place of discharge of rivers; hence the expression is often made use of "the estuary of a river," meaning the mouth of a river. It is derived through the Latin word *æstuarium*, a creek, tideway, or morass, from *æstus*, meaning heat, with the secondary signification of the ebb and flow of the sea.

ETAMPES, a town of France, in the department of Seine-et-Oise, situated 32 miles S. from Paris on the railway to Orléans, in a pretty valley watered by two feeders of the Juine, and has a civil tribunal, a college, an agricultural society, and a population of 8250. It is fairly built and laid out, and surrounded by public walks shaded by fine trees. Of the old castle built by King Robert about 1030, and demolished by Henry IV., there remains only a single tower, called Guinette. The churches of Notre Dame, St. Basile, St. Gilles, and St. Martin, which are remarkable for their antiquity; the town-hall, an ancient turreted structure; and the granary, of modern erection, are the most important public buildings. The town has a large trade in wool and corn, brought from the districts of Beauce and Gâtinais, for the supply of the capital. A great number of flour mills are driven by the Juine and its feeders.

ETCH'ING. See ENGRAVING.

ETE'OCLES. See ANTIGONE.

ETE'SIAN WINDS, those periodical winds which were early noticed by the ancients as blowing from the north-east in the heat of summer, for about six weeks, throughout the Mediterranean, and especially in the Adriatic and the adjacent countries. They were mentioned by Pliny and Seneca; and Cicero says that in Italy they were salutary to animals, and beneficial to vegetation, on account of their tending to moderate the violent heat of midsummer. In the Levant they commence towards the middle of July, and are known among the fishermen by the name of *Meltem*, a corruption probably from *malo tempo*, because of the danger to which the small fishing craft is exposed during their fury. Their cause may be assigned to the powerful heating of the earth under the tropic of Cancer during the dog-days, and the rarefied state of the atmosphere south of the Mediterranean, which doubtless gives birth to the north-east Etesian gales, which rush along with great fury.

E'THAL, or **CETYLIC ALCOHOL,** is the hydrate of cetyl (a monotomic radicle, $C_{16}H_{33}$, existing as a palmitate of cetyl in spermaceti). It is a white crystalline fatty body obtained by saponification of spermaceti. It melts at 48° C. (118° Fahr.) It is soluble in alcohol and ether, but insoluble in water. The formula is $C_{16}H_{34}O$.

ETH'ELBALD (*Æthelbald*), King of Wessex, was son of Ethelwulf, who resigned the throne in 856. [See ETHELWULF.] On the death of Ethelwulf in 858, Ethelbald married his young step-mother, Judith of France. (The tale that, at the instance of St. Swithin, bishop of Winchester, he afterwards abandoned the connection is a later fabrication.) Judith became the wife of Baldwin, count of Flanders, after Ethelbald's death, and thus ancestress of Matilda, wife of William the Conqueror. Through the Conqueror's wife our own present sovereign descends from the Emperor Charles the Great, since her ancestress Judith was great-granddaughter of that wonderful man. Ethelbald died in 860, and was succeeded by his brother Ethelbert.

ETH'ELBERT (*Æthelberht*) was the fourth king of Kent in lineal descent from Hengest, and succeeded his father Ermeric in 560. Ethelbert claimed to be Bretwalda or supreme king in Britain in 589, and assumed the title,

which he retained to his death, though it would seem that he never was acknowledged by the kings of Northumbria.

The most memorable event in the reign of Ethelbert was his conversion to Christianity and the establishment of that religion in his dominions by the ministration of St. Augustine. Ethelbert professed himself a Christian, and was baptized on the feast of Pentecost, 597. After his conversion he exerted himself with zeal in the diffusion of his new faith. He founded the bishoprics of Rochester and London about the year 604, in addition to the archbishopric of Canterbury. Ethelbert's wife, Bertha (*Bercta*), daughter of King Charibert of Paris, was the cause of the mission of St. Augustine. It was also through his daughter, Ethelburga, who married the great Edwin, king of Northumbria, that Christianity was introduced into that state. See Ethelburga.

Ethelbert is the author of the earliest of our written laws, the collection of "Dooms," as Bede calls them, "which he established, with the consent of his witan, in the days of St. Augustine." The collection consists altogether of eighty-nine enactments or clauses, at least as it has come down to modern times. Among these laws, the oldest in any existing tongue (for it must be remembered that we of to-day speak, with modifications, the language of Ethelbert), are many which are of antiquarian interest only, such as those fixing the fines which form so curious a feature of the older English jurisprudence, as the Wergild, &c.; but others are of wider import. It is in this early time that the favour granted to foreign trade, which has now for centuries made England the emporium of the world, first began; and we look with pride upon the careful way in which Ethelbert protected foreign merchants from any interference on the part of his own jealous subjects. It is a sort of primordial cell from which the fruitful tree of free trade is to develop. Another act of Ethelbert's operates to this day; it is the immunity from arrest on civil process granted in 600 by the king, and never repealed, to all members attending the witan, the Old English Parliament, and even covering their servants and their goods; the last part was so greatly abused as to necessitate its repeal in 1770. The immunity was eventually made to last from forty days before to forty days after the session for the Commons, but remained perpetual for the Lords. Ethelbert's words are, "If the king call his people to him, and anyone there to do them evil, let him compensate with a two-fold *bot*, and 50s. to the king." ("Stubbs' Select Charters," sec. 61.)

Ethelbert died in 616, and his shadowy claim to supremacy gave way to the glorious overlordship of Northumbria under Edwin.

ETH'ELBERT (*Æthelberht*), King of Wessex, was the second surviving son of Ethelwulf, and succeeded his elder brother Ethelbald in 860. The chronicles celebrate the courage and military talents which Ethelbert displayed against the Northmen, who continued to make occasional descents on the coasts of Wessex, as well as on those of other parts of the island. Ethelbert died in 866, and was succeeded on the throne of Wessex by his younger brother Ethelred.

ETH'ELBURGA, ST. (*Æthelburh*), was the daughter of Ethelbert, the first Christian king of Kent. The great Edwin of Northumbria, afterwards Bretwalda, demanded Ethelburga in marriage of her brother, Eadbald of Kent; and the latter, though otherwise willing, hesitated to send his sister among the heathen of Northumbria. Edwin promising not only to grant freedom of religion to her and her train, but also to give his consideration to the new religion, the marriage took place, and with Ethelburga went Paulinus the priest. The result was the first or Roman conversion of Northumbria, and the building of the first church at York, wherein Edwin was baptized by Paulinus as bishop. Almost at once the first minster of stone, relics of which exist to this day, began to rise over the wooden church honoured by the baptism of the great Bretwalda. But King Penda, and his still heathen folk of Mercia, rebelled against Edwin's overlordship, and in the battle that ensued Edwin was killed, and Ethelburga, and with her Paulinus also, fled for their lives into Kent. So ended the first conversion of Northumbria. (For particulars of the second conversion, and of the final submission to Rome, see Synod of Whitby.) For her signal service in the conversion of the north Ethelburga was canonized. Churches still exist to her memory—as, for instance, the small ancient structure in Bishopsgate, London.

ETHELFLE'DA (*Æthelflæd*) was the virtual queen of Middle England for some years after the death of her father, Alfred the Great (901). Alfred had recognized the right royal courage and capacity of this noblest of the older English princesses, and had appointed her Lady of Mercia. The men of Wessex never tolerated the title of queen (*Cwen*) since Eadburh of Mercia, queen of Beorhtric of Wessex, poisoned Worr, his ealdorman, and Beorhtric, drinking unwittingly of the cup, died also. They used the word "lady" instead. (A Wessex queen-dowager went by the name, very odd to modern ears, of the "old lady.") Lady Ethelfleda amassed treasure and force for a year or two, and then fell upon the Danelagh, the "five boroughs" of Derby, Lincoln, Leicester, Stamford, and Nottingham, which formed the nest and stronghold of the heathen invaders. Avoiding open fight, Ethelfleda laid siege to Derby, building fortresses behind her to keep open her line of communication. The Welsh thought to profit by her being so far to the eastward, and attacked the western march (*Mercia* means march or frontier); but the brave lady swiftly turned and defeated them, and was back in front of Derby again before the Danes had had time to profit by her absence. Derby fell, then Leicester, and then the great Ethelfleda died, and her brother, Edward the Elder, continued her victorious career. Certainly these were remarkable children of a remarkable father.

ETH'ELRED I. (*Æthelred*), King of Wessex and nominal head of the other English states, was the son of King Ethelwulf, and succeeded his elder brother, Ethelbert, in 866. The reign of Ethelred was eminently disastrous, both for Wessex and the other states. The Danes, who had for the last three reigns been infesting our coasts, in 866 landed in East Anglia, took York, and made themselves masters of all the kingdom of Northumbria south of the Tyne in 869. The next year they attacked Mercia, and thence East Anglia, burning and destroying wherever they came. At a village called Hoxton, in Norfolk, the Danish kings, Ingwar and Hubba, seized Edmund, the East Anglian king, and put him to death; he sustained the torments they inflicted upon him with such constancy that he was afterwards revered as a martyr. His death made the Danes masters of East Anglia. They now resolved to invade Wessex, and they entered and took the town of Reading (871). Numerous encounters with varying success now took place, in which Alfred, the king's brother, bore a distinguished part; but the Danes continued to be supreme in East Anglia, and to maintain, or rather to strengthen, themselves in the rest of the country. In one of these battles, fought at Merton in 871, Ethelred received a wound of which he died soon afterwards, leaving the inheritance of the crown of Wessex to his brother Alfred.

ETH'ELRED II., surnamed *the Unready* (that is to say, the man of no *rede* or right judgment), King of England, was the youngest son of King Edgar by his second wife, the infamous Elfrida. On the murder by Elfrida of his half-brother King Edward the Martyr, in 978, he was reluctantly acknowledged as king by the witan, and crowned by St. Dunstan, at Kingston-on-Thames, on 14th April, being at this time only ten years old. The reign of Ethelred the Unready is on the whole the most calamitous and disgraceful in English history. In 980 the

Danes ravaged the coasts, and after an interval occupied with dissensions of their own, from 982 till 988, they returned annually, until in 991, after defeating the English army at Maldon in Essex, a treaty was concluded, by which they engaged to retire on a payment of 10,000 pounds of silver. This money was raised by an impost on all the landed property in the kingdom, which from this time became a regular tax, under the name of the Danegeld, and was perhaps the first direct tax imposed in England. In 994 a much more powerful armament than had yet appeared sailed up the Thames under the command of Swegen, king of Denmark, and Olaf, king of Norway; it consisted of ninety-four ships, and directed its first efforts against London, which, however, defended itself successfully against the assault. In the end the invaders were again bought off by the payment of a sum of money, their demand this time having risen to 16,000 pounds of silver. Olaf now consented to embrace Christianity, was confirmed by St. Alphegē (*Ælfheah*), and received by Ethelred as his adopted son; and he faithfully kept his promise of never again molesting England. But the King of Denmark continued his attacks year after year; and at last, in 1001, Ethelred was obliged to pay the Danes 24,000 pounds of silver to rid himself of them. It is astonishing to find Ethelred now attacking first Malcolm, king of Scotland, and afterwards, with a considerable force, Richard, duke of Normandy, when he needed to strain every nerve to preserve his own land. In the latter case a peace was soon made, and Richard's sister Emma became Ethelred's second wife. (Edmund the Ironside was the son, not of Emma, but of Ethelred's first wife.) So began the fatal connection with Normandy.

Bribery or tribute was evidently ineffective to get rid of the Danes, and Ethelred resorted to another and a worse mode of dealing with the evil. On 13th November, 1002, the English inhabitants, in obedience, it is said, to secret instructions received in every city from the government the evening before (suggested to the king by his favourite EDRIC), suddenly rose in all parts of the kingdom upon the Danes who were resident among them, and put them to death—men, women, and children. The next year Swegen, whose sister had been among the butchered, again appeared on the south coast; and from this time it may be said that the kingdom had no rest. After continual devastations, and frequent exorbitant payments (St. Alphegē meeting his death at Edric's hands because he would not contribute to the shameful payments), Swegen at length made himself master of Northumbria, advanced to Bath, where he caused himself to be proclaimed king of England, marched to London, which submitted to him; and in January, 1014, Ethelred fled to the court of Richard, duke of Normandy, his brother-in-law.

Swegen, however, died 3rd February, 1014, and Ethelred was recalled to England by an unanimous impulse, to which Canute (Cnut), the son of Swegen, deemed it prudent to give way. Canute, however, returned, and was preparing to attack London, when Ethelred died 23rd April, 1016. He was succeeded by Edmund, surnamed Ironside, his son by his first wife Elfleda, Canute being elected by a witan at Southampton, and Edmund by another witan at London. Edward, one of his two sons by Emma of Normandy, also afterwards ascended the throne. See EDMUND IRONSIDE, EDWARD THE CONFESSOR.

ETH'ELWULF (*Æthelwulf*) was the son of Egbert the Great, whom he succeeded on the throne of Wessex and in the supremacy over the other English states in 837. The first fourteen or fifteen years of the reign of Ethelwulf passed in a series of contests with the Danes, who now continued with incessant perseverance those descents upon the English coasts which they had commenced in the preceding reign. In 851, having ascended the Thames with a fleet of 350 vessels, landed an army, and plundered Canterbury and London, they were completely defeated at Ockley in Surrey, and did not again make any attempt on England during the reign of Ethelwulf.

In 855 Ethelwulf undertook a journey to Rome, accompanied by his youngest son Alfred (Alfred the Great). On his return through France he fell in love with Judith, the young daughter of Charles the Bald, king of that country, and married her. Meanwhile, however, his eldest son Ethelbald, taking advantage of his father's absence, had entered into a scheme for seizing the throne; and although the return of Ethelwulf is said to have prevented the full success of the design, it was substantially carried into effect. Ethelwulf gave up Wessex to his rebellious son, and retired to the smaller kingdom of Kent with his young queen Judith. It is only right to say that this account of the deposition, due to Asser the biographer of Alfred the Great, does not appear in the Chronicle. Ethelwulf spent the remainder of his days mostly in exercises of devotion, and died in 858. He was buried at Winchester.

E'THER is the name given to the assumed medium pervading all space, even the interstellar space, by the vibrations of which, according to the undulatory theory, light is conveyed. As the luminiferous ether is, by hypothesis, without resistance, colour, or weight, it is hardly necessary to say that its existence is purely theoretical. It seems certain that so violent an assumption without any basis of proof will not hold against the researches of science of some future age; meanwhile, as it at present answers to every fact, the existence of ether stands as a good working hypothesis, and is accepted by all. See LIGHT.

E'THER, a light and highly volatile combustible fluid, produced by the action of sulphuric acid on spirit of wine or alcohol. It is usually obtained by distillation from a heated mixture of alcohol and sulphuric acid. It may also be obtained by the action of phosphoric or arsenic acid on alcohol. It was first discovered by Valerius Cordius in 1540, and called *oleum vitriolo dulce*, and afterward sulphuric ether. It is also known as ethylic or vinic ether. It is a colourless transparent liquid, of a pleasant smell and pungent taste, extremely exhilarating, and producing anæsthesia when its vapour is inhaled. Its specific gravity is 0·723. It evaporates so rapidly that if we put some into a small glass vessel surrounded with cloth and containing water, and after dipping it two or three times into ether, allow the ether to evaporate, the water in the glass freezes by the cold produced. In the open air ether boils at 35·6° C. (96° Fahr.) Exposed to a temperature of —31° C. it becomes a crystalline solid.

The vapour density is 2·564; and from its great density the vapour can be easily poured from one vessel to another. It is extremely inflammable, and forms a dangerously explosive mixture with air. Water dissolves about one-tenth of its volume of ether, but it is soluble in all proportions in alcohol. It is a good solvent of fats, oils, and resins, and some of the alkaloids. Sulphur and phosphorus are soluble in it, the latter solution leaving, on evaporation, the phosphorus in a fine state of division, luminous in the dark. It is a valuable and safe anæsthetic. From its great volatility and low boiling point it has come into use in refrigerating machines. The formula is $C_4H_{10}O$.

Ether is the oxide of ethyl. It forms the base of an extensive series of organic compounds formed by the action of the various acids on alcohols, and known generally as ethers. Some of these are simple ethers, others compound, and of great complexity. The simple ethers are the oxides of the alcohol radicles, and are related to the alcohols as an oxide to its hydrate. The following are some of the best known simple ethers:—Methylic ether, or oxide of methyl (C_2H_6O); ethylic ether, or oxide of ethyl ($C_4H_{10}O$); amylic ether, or oxide of amyl ($C_{10}H_{22}O$); phenylic ether, or oxide of phenyl ($C_{12}H_{10}O$). The first is a gas, the others are liquids. There are many more of these, and all yield

chlorinated and other derivatives, forming a large series of organic compounds.

The most important of the compound ethers are the following:—

Boric Ether, or Borethyl ($C_6H_{15}B$), is an irritating pungent liquid, of specific gravity 0·696, and boiling at 95° C. (203° Fahr.) It is spontaneously inflammable, burning with a green flame.

Ethyl Bromide, or Hydrobromic Ether (C_2H_5Br), is a volatile heavy colourless liquid, of specific gravity 1·40, and boiling at 40·7° C. (104° Fahr.) It is an anæsthetic, and slightly soluble in water.

Ethyl Chloride, or Hydrochloric Ether (C_2H_5Cl). This compound has been long known. It is a light inflammable colourless liquid, of specific gravity 0·920, and boiling at 11° C. (52° Fahr.), and slightly soluble in water. It is much used in medicine diluted with alcohol. There are a number of compound chlorinated derivatives of this ether.

Ethyl Cyanide (C_3H_5N) is a colourless liquid insoluble in water, having a specific gravity of 1·431, and boiling at 105° C. (221° Fahr.)

Ethyl Fluoride (C_2H_5F) is a volatile inflammable liquid, having an odour of horse-radish.

Ethyl Iodide (C_2H_5I) is a colourless liquid of ethereal odour, of specific gravity 1·920, and boiling at 70° C. (158° Fahr.) It is a valuable reagent much used in the laboratory for attacking organic bodies, and has given rise to a large number of substitution products.

Ethyl Sulphydrate, or Mercaptan (C_2H_6S), is a liquid of a most offensive and persistent garlic odour. It is very volatile and inflammable. Its specific gravity is 0·832, and it boils at 62° C. (144 Fahr.)

Ethyl Nitrite ($C_2H_5NO_2$) is a pale yellow volatile liquid with an agreeable odour of apples. The specific gravity is 0·947, and it boils at 16·4° C. (61° Fahr.) This is the active ingredient in the well-known sweet spirit of nitre of pharmacy.

Ethyl Silicate, $(C_2H_5)_4SiO_4$, is a colourless inflammable liquid, with pleasant ethereal odour and hot taste. The specific gravity is 0·933, and it boils at 165° C. (329° Fahr.) It is decomposed by water.

Ethyl Acetate, or Acetic Ether ($C_4H_8O_2$), is a very fragrant limpid liquid, having a specific gravity of 0·890, and boiling at 73·8° C. (165° Fahr.)

Some of the ethers of the organic acids are employed as flavouring essences. The best known is ethyl butyrate ($C_6H_{12}O_2$), or essence of pine-apple. [See BUTYRIC ETHER.] In combination with zinc, mercury, and other metals it forms the so-called organo-metallic bodies, of which the first discovered and the most important is zinc ethyl (ZnC_4H_{10}). This is a very remarkable liquid, having a disagreeable odour; it is very volatile, and takes fire immediately in contact with air.

ETH'EREGE, SIR GEORGE, was born about 1636, and was a distinguished wit and dramatic writer of the reign of Charles II. In 1664 he produced the comedy called "Love in a Tub." "She Would if she Could" followed in 1668, and "The Man of Mode, or Sir Fopling Flutter," in 1676. All were received with much favour by the public of that disgraceful day. Ease and brilliance of dialogue are their characteristic excellences; but their licentiousness has long excluded them from the stage. Etherege was in James II.'s household, and was employed by that king as minister to Ratisbon, where he died about 1694, by breaking his neck in a fall downstairs when he, as a drunken host, was lighting a party of drunken guests out from an orgie. Fit end for such a man.

E'THERIN and **E'THEROL,** two bodies contained in the heavy oil of wine resulting from the manufacture of ether. Etherin is found in colourless prismatic crystals, which melt at 110° C. (230° Fahr.), and boil at 260° C. (500° Fahr.) It is insoluble in water, but soluble in alcohol and ether. Etherol is a yellow liquid, of specific gravity 0·921, boiling at 280° C., insoluble in water, but soluble in alcohol and ether.

ETH'ICS is the science which relates to our mental affections, not simply as phenomena, but as they are virtuous or vicious, right or wrong. The term is derived from the Greek *êthikê*, which in signification is equivalent to the Latin *mos*, *mores*, whence the adjective *moralis*, and the English word *morals*, synonymous with ethics. Aristotle, in the second book of his "Nicomachean Ethics," says that moral science received the name of ethics from the word *êthos*, use or custom, since it is from habitual experience and the routine of customary conduct that moral dispositions and principles are gradually formed and changed. Cicero, in his work on moral ends ("De Finibus") briefly defines ethics, or morality, as "ars vivendi," or "doctrina bene vivendi," that is, the art of living virtuously.

Ethics (or morals, moral philosophy, or moral science) denotes specially the science of what is called man's duty, what he ought and ought not to think, feel, say, do. This is the most convenient use of the word, and is now generally sanctioned by custom. *Morals* and *ethics* are also names for the art corresponding to the science which has just been spoken of, the art of performing one's duty. The art and the science being co-extensive, and differing only in this, that the same subject-matter is viewed from different points, the indiscriminate application of the same term to both engenders no confusion worthy of notice.

Morals, lastly, in current conversation, is synonymous with *morality*; thus denoting not only the science and the art, but also what is the subject-matter both of the one and of the other.

Ethics, then, is a name for the science which teaches what it is man's duty to do and not to do, or what he ought and ought not to do; or again, what it is respectively right and wrong for him to do; or which teaches what is virtue and vice.

The word duty implies obedience to some fixed rule, and the word rule implies ruler. There is only one supreme ruler, and that is God. All morality then has reference to a supreme power, or to a belief in powers whose will is a law or rule to man. The duties which a man owes are to God and to his neighbour. Those which he owes directly to God belong to the province of religion; those which he owes to his neighbour are alone the proper field of ethics, which, in truth, is a department of practical conduct. This second part of a man's duty is thus expressed by some writers—the conduciveness of a thing to the general happiness of mankind is the criterion of duty. To know therefore a man's duty fully, we must, according to this statement, know what is conducive to the general happiness of mankind. Thus a foundation is laid for a wide investigation, which may form a science of morals.

The existence of the considerable body of moral philosophy of the Greeks and Romans shows clearly that morality does and must exist independent of revelation. Whether those nations which accept Christianity can be considered as having any system of morals independent of it, would seem an idle question; for the Christian revelation, though it does not give a complete body of rules for moral conduct, cannot be considered a sufficient revelation if it does not contain enough to solve every moral question that may arise. But as there are many nations which do not accept Christianity, and some individuals in Christian nations who do not accept it, though all such nations and all such individuals nevertheless admit the necessity of some moral rules, it is a proper subject of investigation to ascertain what such rules are, and what is their criterion.

To make the pursuit of a man's true happiness a rule of life, and the furtherance of human happiness generally

a duty and indeed the only means of obtaining true happiness, are now usually granted as the aims of ethics. Writers on morals differ very little as to the rules of morality. The difference lies in establishing the foundation and criterion of them; and it appears to be an error to found them on an innate or revealed principle only, such as that which is sometimes called the Moral Sense [see CONSCIENCE], instead of on the practical criterion of conduciveness to the general happiness. We do possess a power by which we approve or condemn many acts directly, without any reflection or consideration of general consequences, but this power can be traced to its sources in inheritance, in the accumulated judgment of men learned by education, and in the teachings of experience, so that every man has a store of ready-made judgments for ordinary cases. In all new cases, or in important ones, however, it is undoubted that we look to the consequences of our actions to ourselves and to others as a measure or criterion by which to judge them. The main divisions of ethics are—(1) the *Ethical Standard:* why should I or should I not do this? Under CONSCIENCE and UTILITARIANISM this is fully discussed, as well as (2) the *origin* and nature *of conscience* or the moral sense. Another question is, (3) What is the end of life? the *summum bonum* discussed in this work under UTILITARIANISM; and finally, (4) a *classification of duties* is necessary. This last varies so curiously from age to age that it would be difficult to find a more interesting and in many points amusing book than Lecky's "History of European Morals" (London, 2nd edition, 1877).

ETHION'IC ACID, the anhydrous acid, also called sulphate of carbyl, is obtained from olefiant gas by acting on it with sulphuric acid. It forms deliquescent crystals, which melt at 80° C. (176° Fahr.) These are soluble in water, forming ethionic acid. The formula is $C_2H_4 2SO_3$. The acid is dibasic, and forms a series of crystalline salts called ethionates.

ETHIO'PIA, the Biblical *Kush*, was the name given by the ancient geographers to the countries south of Egypt. In a more general and vague sense they called all the inhabitants of the south part of Africa, from the Red Sea to the Atlantic, Ethiopians. The Greek word *Aithiopia* was supposed among the common people to mean simply the land of the scorched faces, from *aithein*, to burn, and *ops*, the countenance. Eastern Ethiopia, properly called Ethiopia above Egypt (Herod. vii. 69) and also Ethiopia Orientalis, was a distinct and better defined country. It included those regions which we now call by the names of Nubia and Sennaar, and perhaps part of Abyssinia, but to the south its limits were not known. Meroe, which lay above the confluence of the Astaboras (Tacazze) and the Nile, was the ancient capital of this Ethiopia. Ethiopia was a country early reduced to a fixed social state. Its government was monarchical, but the monarch was subordinate to an all-powerful hierarchy, more absolute than that of Egypt. The palmy times of the Egyptian empire (eighteenth and nineteenth dynasties) saw Ethiopia subject to Egypt; but the twenty-fifth dynasty was Ethiopian, Shabak, a usurping conqueror, having invaded Egypt from the south. It was overthrown 685 B.C.

Under the Ptolemies Græco-Egyptian colonies found thei way into the regions of the Upper Nile, and along the shores of the Red Sea; these colonies probably extended the Egyptian arts as improved by the Greeks into Ethiopia. All these vicissitudes may account for the various styles of building and sculpture found along the banks of the Upper Nile. In the time of the second Ptolemy the Ethiopians had a king, Ergamenes, who had a knowledge of Greek manners and philosophy. Although the Romans are known to have made several expeditions into Ethiopia, very little is known of the period or mode of the extinction of the Meroe dynasty. Of the manners of the Ethiopians we know little. Their sacred language appears to have been the same as that of the Egyptian priests. From some sculptures at Barkal it would seem that human sacrifices were occasionally in practice. A peculiarity in the Ethiopian institutions is, that their women sometimes went to battle, and were not excluded from the throne.

ETHIO'PIAN LANGUAGES. Under the general designation of the Ethiopian languages three different dialects are usually comprised, the ancient Ethiopian or Geez, the Tigré, and the Amharic. The ancient language properly called the Ethiopian is now extinct, or at least survives only in Abyssinia as a literary and especially an ecclesiastical language (whence it is also called *lesana mas'haf*, or book-language); and its place is now supplied by the two other dialects, of which the Tigré approaches nearest to the Ethiopic, while the Amharic has more widely departed from it. The Ethiopian belongs to the family of languages usually called the Semitic, and among them it shows the closest affinity to the Arabic. It is written from the left to the right, in a peculiar alphabet, which however appears to be of Semitic origin.

The Abyssinians possess a complete Ethiopian translation of the Old and New Testaments, made by an unknown author from the Alexandrine text of the Greek version, probably not anterior to the fourth century; besides an apocryphal writing peculiar to themselves, called the Book of Henoch or Enoch, which is supposed by De Sacy to have been written during the reign of Herod the Great, and to be the book quoted in the Epistle of St. Jude, ver. 14. It was first studied by Potgen of Cologne in 1538; but the great lexicon of Ludolf was the work which fully opened this interesting language to students. Since then it has received much attention, as it has many linguistic peculiarities.

ETHNOL'OGY (Gr. *ethnos*, nation; and *logos*, discourse) is a division of ANTHROPOLOGY which deals more particularly with man regarded as a social being. It considers the tribe and the nation; compares superstitions, customs, institutions; and investigates the principles involved which lead mankind onward and upward in material, intellectual, and religious development. There is a very general agreement among ethnologists that this development of man may be illustrated by the condition of savage and half-civilized tribes at the present day, which resembles "the earlier mental stages through which the human race has passed" (Lubbock). The study of the remains of prehistoric man is complementary to that of modern barbarous tribes. Franklin defined man as a tool-making animal, and one of the most important branches of the inquiry into the material progress of man consists in the study of his weapons and tools. Another branch is the question of the supply of food, and the improvements that have been effected in the means of obtaining it; we may roughly classify the stages through which man has passed as those of hunting and fishing, keeping cattle, tilling the ground, and finally the industries which are the product of a higher civilization. Besides these we have to consider the questions of clothing, dwelling-places, and trade.

Although the common opinion is that the family was the fountain-head of all other institutions, there is no doubt that the idea had to grow and be developed. The children of one woman kept round her, the children's children also kept together, and thus possibly the family and the clan were developed. Lubbock points out that "children were not in the earliest times regarded as related equally to their father and their mother; but the natural progress of ideas is, first, that a child is related to his tribe generally; secondly, to his mother, and not to his father; thirdly, to his father, and not to his mother; lastly, and lastly only, that he is related to both." Languages are of great service to the ethnologist, but are apt to be misleading,

unless the conclusions are corrected by other characteristics. Their value is shown by the achievements of philologists, who have "reconstituted the social state, the uses, the ideas, the beliefs of the ancient Aryas, whose moral history is now better known to us than some periods of Roman history." Other branches of inquiry are religious development, myths, superstitions, law, and morals.

To use the words of Tylor—"The ethnographer's business is to classify such details with a view to making out their distribution in geography and history, and the relations which exist among them. To the ethnographer the bow and arrow is a species, the habit of flattening children's skulls is a species, the practice of reckoning numbers by ten is a species. The geographical distribution of these things, and their transmission from region to region, have to be studied as the naturalist studies the geography of his botanical and zoological species. Just as certain plants and animals are peculiar to certain districts, so it is with such instruments as the Australian boomerang, the Polynesian stick-and-groove for fire-making, the tiny bow and arrow used as a lancet or phleme by tribes about the Isthmus of Panama; and in like manner with many an art, myth, or custom found isolated in a peculiar field. Just as the catalogue of all the species of plants and animals of a district represents its flora and fauna, so the list of all the items of the general life of a people represents that whole which we call its culture. And just as distant regions so often produce vegetables and animals which are analogous, though by no means identical, so it is with the details of the civilization of their inhabitants. How good a working analogy there really is between the diffusion of plants and animals and the diffusion of civilization comes well into view when we notice how far the same causes have produced both at once. In district after district the same causes which have introduced the cultivated plants and domesticated animals of civilization have brought in with them a corresponding art and knowledge. The course of events which carried horses and wheat to America carried with them the use of the gun and the iron hatchet, while in return the Old World received not only maize, potatoes, and turkeys, but the habit of smoking and the sailor's hammock."

E'THYL, a radicle having the formula C_4H_{10}. It is a colourless inflammable gas, burning with a luminous flame.

ETHYL'AMINE or **ETHYL-AMMONIA,** an organic base formed by the substitution in ammonia of ethyl for hydrogen. It is a colourless inflammable liquid, of specific gravity 0·696, and boiling at 18·7° C. (66° Fahr.) It is a strong alkali, very soluble in water, and resembles ammonia in its reactions. It forms with bases well-defined crystallizable salts, mostly soluble in alcohol, in which they differ from ammoniacal salts. Its formula is

$$C_2H_7N, \text{ or } N \begin{cases} H \\ H \\ C_2H_5. \end{cases}$$

Diethylamine, containing two atoms of ethyl,

$$(C_4H_{11}N), \text{ or } N \begin{cases} H \\ C_2H_5 \end{cases} \\ C_2H_5,$$

and Triethylamine, containing three atoms of ethyl,

$$C_6H_{15}N, \text{ or } N$$

are both inflammable liquids of ammoniacal odour, and form salts similar to those of ethylamine.

E'THYLENE, Olefiant Gas, or Heavy Carburetted Hydrogen, a gas discovered in 1795 by Dutch chemists. It is prepared by heating alcohol with strong sulphuric acid. It is often found among the products of destructive distillation of organic bodies, and is an important illuminating constituent of coal gas. It is a colourless gas with etherial odour; under great pressure and intense cold it can be condensed to a liquid. It is very inflammable, and burns with a bright luminous flame. It explodes violently with oxygen, and burns with a smoky flame in chlorine, depositing charcoal. The formula is C_2H_4.

The name of olefiant (oil-giving) gas is derived from the action of chlorine on it. The two gases combine to form a heavy oily liquid of sweetish taste and etherial odour, to which the name of Dutch liquid is given. This compound is ethylene chloride ($C_2H_4Cl_2$).

ETIENNE, ST., a large manufacturing town in the department of Loire, in France, stands in a narrow valley on the Furens, a small feeder of the Loire, 288 miles S.S.E. from Paris, and has 120,120 inhabitants. It is situated at the junction of the railways that lead to Lyons and Roanne, from which it is distant respectively 35 and 51 miles. The older part of the town is ill built; the modern part is well built, with spacious squares, lofty houses, and wide and regular streets; and the whole, always enveloped in the opaque dense smoke of its numerous workshops and factories, is superlatively dirty. The finest street is that through which the road from Paris to Marseilles runs; it divides the town into two nearly equal parts. In the middle of this street and of the town stands the town-house, which, with the exception of an ancient church that dates from the eleventh century, is the most remarkable structure in St. Etienne. The town is well supplied with water from the Furens.

St. Etienne stands in the centre of one of the most important coal-fields in France, from which about 600,000 tons of coal are exported annually. It is especially famous for the manufacture of silk ribbons and firearms. Its ribbons, which are exported to all parts of the world, are unequalled for richness of colour and beauty of pattern, and of the quantity manufactured an idea may be formed from the statement that their value amounts annually to upwards of 80,000,000 francs. The manufactures next in importance are those of firearms, hardware, and cutlery. To these leading objects of industry are to be added manufactures of scythes, nails of all kinds, saw-blades, foils, anvils, vices, files, silk and cotton velvets, &c. The town has also many dye-houses and tanyards; and in the suburbs of Terre-Noir there are important iron forges and furnaces.

St. Etienne is the seat of tribunals of first instance and of commerce; it has a consultative chamber of manufactures, conseil des prud'hommes, a college, a school for deaf-mutes, a mining-school, a small theatre, a public library, and a museum which contains a collection of the minerals and fossils of the neighbourhood, and also specimens of the staple manufactures of the town. The population of St. Etienne has more than trebled within the last fifty years.

Some authors have supposed that this town occupies the site of the ancient *Furanum*, built by the Romans 65 B.C.; but this is very doubtful, and no annals of St. Etienne go further back than the tenth century. In 1441 the town consisted of only 200 indifferent houses, which Charles VII., a few years afterwards, suffered the inhabitants to surround with a wall to protect themselves from the incursions of the English. A few vestiges of this wall still exist, but it did not prevent St. Etienne from suffering greatly in the religious wars of the sixteenth century. The plague destroyed 7000 of its inhabitants in 1585, and 8000 in 1628–29.

ET'IQUETTE, a word signifying the forms and decorums of polite society, and teaching the rules of good behaviour in the intercourse of life. Books on etiquette are often published, but true breeding and natural refinement will usually be the best guide.

ETNA or **ÆTNA** (known in Sicily as *Mongibello*), a celebrated active volcano in Sicily, situated in the north-

eastern part of the island, close to the sea-coast, between the towns of Taormina and Catania. It is the greatest volcano in Southern Europe, and exhibits some of the most striking instances of the revolutions which the crust of the earth has undergone or is undergoing.

The base of Etna covers an area nearly 90 miles in circumference, and the highest point is 10,874 feet above the level of the sea. Owing to this great elevation, together with the difference in the nature of the soil, there are three great natural divisions or zones in the mountain—the *fertile*, the *woody*, and the *desert*. About 1100 feet from the summit there is an irregular plain, estimated to be 9 miles in circumference, and from this plain rises the steep terminating cone, at the summit of which is the great crater or opening, continually throwing out sulphurous vapours. The dimensions of the crater have been very variously stated by different travellers, the circumference from 2½ to 4 miles, and the depth from 600 to 800 feet; but the height of the cone, the diameter of the crater, and its depth, are liable to constant change from the eruptions. Although, taken as a whole, Etna forms a cone which is in general of a very symmetrical form, when examined in detail it is found to be studded on its flanks, and particularly in the woody region, with numerous minor cones. The eastern side is broken by a deep valley or amphitheatre 4 or 5 miles in diameter, surrounded by vertical precipices, varying from 1000 to 3000 feet in height. There is no ground for supposing that the altitude of Etna has materially varied within the last 2000 years. Of the eighty most conspicuous lateral cones not one of the largest has been produced within the period of authentic history.

There are about sixty eruptions recorded in history from the earliest to the present times. Of these ten happened before the Christian era, twelve in the next 1500 years, seventeen during the sixteenth and seventeenth centuries, and somewhat above twenty from that time to the present. Diodorus Siculus speaks of old eruptions of Etna said to have taken place long before the Trojan War, and to have occasioned the emigration of the Sicani, the earliest inhabitants of the island, who were afterwards replaced by the Siculi from Italy. An eruption is recorded to have occurred in the time of Pythagoras, who is believed to have died 504 B.C. Another took place 475 B.C., and is alluded to by Æschylus and Pindar. Others are mentioned as having occurred in 425 and 396 B.C., the latter of which stopped the Carthaginian army in their march from Messina to Syracuse, and obliged them to go round the whole base of the mountain in order to reach Catania. This stream of lava may be seen on the eastern slope of the mountain, near Giarre, extending over a breadth of more than 2 miles, and having a length of 24 from the summit of the mountain to its final termination in the sea.

Most of the eruptions have presented such similar features, that it will be more interesting and instructive to describe one in detail than to give mere dates or outlines of all. The following is Ferrara's description of the eruption of 1792:—"On the first days of March the mountain emitted thick clouds of smoke, and at night flames were seen to rise to a considerable height. On the 8th it shook violently, and for several days awful roarings were heard, which appeared to proceed from the innermost cavities of Etna. During April the mountain was tolerably quiet, except that smoke and flames were occasionally seen issuing from its summit. In the beginning of May immense masses of smoke rose in perpendicular columns, and on the 11th lava was seen to flow from the great crater. Meantime shocks of an earthquake were felt at Messina; and on the morning of the 12th the internal roaring was repeated, the black smoke rose in the air in the shape of a gigantic tree, spreading its top to an immense extent around, and in the midst of these dense masses of black smoke were seen numerous globes of white smoke as fleecy as cotton. Towards eleven o'clock A.M. of that day an explosion, like the discharge of heavy artillery, was heard and felt all around the base of Etna, followed by a hollow rumbling noise, and the black smoke arose with fresh violence. In the evening the lava flowed down the sides of the mountain in several streams 8 or 10 miles in length. On the 13th the mountain became more quiet, and remained so till the 23rd, only sending forth a shower of ashes and hot sand, which fell all around its sides. On the 23rd the black smoke reappeared, and the next day a new mouth opened itself, from which, for several days, blocks of old lava and scoriæ were thrown to a great height, as well as masses of clay, moist and soft. On the 26th another mouth opened in the same direction, and vomited a stream of lava. On the 1st of June a large mouth opened itself half-way up the southern side of the cone of the mountain, and from it a huge torrent of lava issued forth, which ran down the immediate slope beneath, then against one of the numerous conical hills which rise round Etna, and was there forced round into a valley 400 feet deep, which had been formed by the waters, and which sloped down to the eastward into the cultivated plain and the vineyards. The lava soon filled up the valley, where it began to harden; but the liquid streams from the heights still pouring in, pressed against it, so that now and then an enormous mass of half hardened lava would detach itself, and having slidden some distance down the declivity, would break up with a tremendous crash into a thousand fragments, and cover a fresh extent of ground. The sight was extremely awful and grand, especially by night. The eruption continued for a whole year, till May, 1793. The stream of lava in its fluid state was often 30 feet high. The lava that flowed first cooled and became condensed at a certain distance, and thus formed a dyke against the current of fresh lava, which swelled up and overflowed its own bed, increasing in height at every fresh overflowing. Thus in many places strata of lava have been formed more than 300 feet high."

In 1874 an outbreak took place which left a great fissure in the mountain some distance from the crater, and from this fissure the pent-up forces of the volcano burst forth in 1879 with much violence. Another eruption took place at the same time from another part of the mountain, the lava streams meeting and commingling lower down. In its course the stream liquefied great accumulations of snow, which flowed down as a furious torrent; at another part it destroyed the wood of Collebasso, together with some of the most cultivated land in Sicily. The fiery flood ultimately stopped about 7 miles from its source, 500 yards from the river Alcantara, and half a mile from the town of Mojo. Had it reached either river or town the damage would have been extremely serious. In 1880 Professor Silvestri, who was deputed by the Italian government to observe the eruption, presented a report upon the subject, in which he made some interesting additions to the science of vulcanology.

For more than half the year the upper part of the mountain is covered with snow; and it forms the great store from which Sicily and Malta are supplied in summer with that necessary of life in a hot climate. After the hot summer of 1828 a search was made for an additional supply of snow, and this elicited the curious fact that a glacier or field of ice had been prevented, perhaps for ages, from melting by being covered with a stream of lava. One of the wonders of Etna is a chestnut tree, known by the name of the Castagno de' Cento Cavalli, because it is said to be capable of sheltering a hundred horses under its boughs. It appears to consist of five large and two smaller trees, which, from the circumstances of the barks and boughs being all outside, and that they are united in one below the ground, are considered to have been one trunk originally. The largest trunk is 38 feet in circumference, and the

circuit of the whole five, measured just above the ground, is 168 feet. It still bears rich foliage and much small fruit, though the heart of the trunk is decayed, and a public road leads through it wide enough for two coaches to drive abreast. In the middle cavity a hut is built for the accommodation of those who collect and preserve the chestnuts. From the best evidence this tree is supposed to be some thousands of years old.

The ascent of Etna is a work of great fatigue, especially in the upper or desert region, both on account of the heat and of the feet sinking and receding at every step in the loose ashes. But under favourable circumstances of weather the labour is amply rewarded by the magnificence of the vast prospect, varied as it is by the view of Sicily itself, spread out like a map, by the islands with which the surrounding sea is studded, Stromboli pouring forth volumes of smoke, and by the distant shores of Italy.

There is little doubt that the name is derived from the Greek *aithein*, to kindle. Pindar is the oldest extant author (about 500 years B.C.) who takes any notice of the eruptions of Etna; and his account is peculiarly interesting, inasmuch as it appears from his representing its summit as supporting the heavens, and being covered with perpetual snows and frost, that it must then have been about as high as at present. According to the ancient poets, Jupiter, after the overthrow of the giants, buried the hundred-headed Typhœus under this mountain, and its earthquakes and eruptions were said to be occasioned by the struggles of the monster.

E'TON, a town of England, in the county of Bucks, is situated on the north bank of the Thames, opposite to Windsor, with which it is connected by a bridge. In fact, although they are in different counties, the two may almost be said to form only one town. Eton is 21 miles west of London by road, and 25½ by the Great Western and London and South-western railways. It consists principally of one long well-paved street, lined with good houses. It is chiefly dependent on its college. The population in 1881 was 3984.

E'TON COLLEGE was founded and endowed by Henry VI., as the "College of the Blessed Marie of Eton by Wyndesore." The foundation charter is dated at Windsor, 12th September, 1440. It was confirmed by Act of Parliament at Westminster, 4th May, 1441. The statutes of Eton College are printed in the Parliamentary Reports on the Education of the Lower Orders, 1818. The original foundation was a provost, ten priests, four clerks, six choristers, twenty-five poor grammar scholars, and a master to teach them, and the like number of poor men. It now consists of a provost, ten fellows, who constitute the governing body, two conducts, seven clerks, seventy king's scholars, and a number of inferior officers and servants. The foundation scholars are called collegers, and are admissible from the age of twelve to fifteen. There are several valuable scholarships, chiefly to King's College, Cambridge, open for competition to the foundation scholars. Besides the scholars on the foundation Eton College is attended by upwards of 800 scholars, called Oppidans, many of whom are the sons of persons of rank and fortune, and board with the masters, from whom they receive instruction. The average expenses of an Oppidan amount to about £200 per annum. The income of the college from its endowments at present amounts to about £20,000 a year, derived from reserved rents, corn rents, sale of woods, and also from manors, by fines and heriots. The college has about forty livings in its gift.

The college buildings are a conspicuous and ornamental object, especially if viewed from the terrace of Windsor Castle. The chapel, which is built of stone, is externally a handsome structure, and the interior has been recently restored. The college hall has recently been remodelled and almost entirely rebuilt. In 1862 an extensive block of school buildings was erected at a cost of £10,000, and in 1870 a convenient laboratory, with spacious lecture and class rooms, was added.

ETRETAT, a town of France, in the department of Seine-Inferieure, 15 miles E.N.E. of Le Havre. It was formerly a small fishing village much frequented by artists, but has now become a fashionable watering-place. The old church has some interesting work of the early part of the thirteenth century. The situation is most picturesque, the town being situated at the mouth of a long valley opening on the sea, and bounded by high cliffs of white chalk, worn into caverns, arches, and needles by the action of the waves. It is a favourite bathing place. Population, 2000.

ETRU'RIA was the name given by the Romans to a region of Italy extending from the river Macra to the Tiber, and from the Apennines to the Tyrrhenian Sea, the inhabitants of which they called Tusci, and at a later time Etrusci. The natives of Etruria, however, called themselves Rasena. The Greeks called them Tyrrheni. The Tusci or Etrusci were settled in Italy north and south of the Apennines, in the plains of the Po and on the banks of the Arno, some time before the assumed foundation of Rome. They had conquered a great part of this vast tract of country from the Umbri, one of the oldest Italian people of which history has preserved the name, and had become a great and flourishing state at least seven centuries before the Christian era. Of the great plain of the Po the Etrusci occupied the central part, from the left bank of the Ticinus and the right bank of the Trebia, which separated them from the Ligurians on that side, to the Athesis or Adige, which divided them from the Veneti, who remained in possession of the coast of the Adriatic as far as the mouths of the Po. (Livy, v. 33.) South of the Po the Ligurians retained possession of the highlands of the Apennines as far eastward as the sources of the Arno, which river formed at first the boundary between them and the Etruscans, who afterwards extended to the Macra, where they built Luna. Of the Etruscan towns in the plain of the Po, Mantua and Felsina (Bologna) were the only two remaining in the time of Pliny. The others had been destroyed by the Gauls long before.

Towards the south Etruria is known to have extended as far as the Tiber previous to the existence of Rome. But the Etruscans at one period went also south of that river. Their regular settlement in Campania, where they are said to have also built twelve towns, was, however, of a later date, probably in the second or third century of Rome, when the Etruscan power south of the Apennines was at its height, and after they had lost by the Gallic irruption all that they possessed in the plains of the Po. The extent of the Etruscan possessions in Campania, and the number of towns which they built or colonized there, are matters of much doubt.

The permanent power of the Etruscans lay in Etruria Proper, or Etruria Media, as it has also been called, which corresponds roughly to the present Tuscany, extended to the right bank of the Tiber. They had twelve principal cities or states, all situated between the Arno and the Tiber. Little was the patriotism and loose the compact which united the different cities. Each intent on its own aggrandizement, each more jealous of its Etruscan neighbour than of the downright foreigner—such a league was ill calculated to withstand the strongly-centralized power of Rome. The names of the twelve have not been handed down to us with any certainty, but Veii, the sworn foe of Rome; Cære (now Cervetri), so long her friend; Tarquinii, whence the Roman dynasty of that name; Volsinii (Bolsena), Vetulonia, Clusium (Chiusi), Perusia (Perugia), Fæsulæ (Fiesole), and Cortona, were undoubtedly among the most powerful. Similar leagues bound together the Etruscans north of the Po and the colonies in Campania.

At least seventeen cities are mentioned as claiming to

belong to the twelve confederates or populi, as they were called. Either some of the original towns, having decayed in influence and prosperity, had been replaced by others of later growth, or each populus may have had more than one capital city. However this may be, no populus was allowed more than one representative vote in the general assembly. The government was conducted in each city by a close aristocracy, with a chief magistrate or lucumo at its head. The nobles were both magistrates and priests; indeed, the whole civilization of the Etruscans was overshadowed by a hierarchical influence, of which the best known parallel is to be found among the ancient Egyptians.

What Lucan said so finely of the river Nile has long been of equal application to the Etruscan people—

"Nec licuit populis parvum te, Nile, videre."

They appear upon the stage of history in full maturity, in the possession of a well-established empire, and the enjoyment of an ancient civilization. The most various surmises have been made as to their race and origin. Herodotus calls them Lydians, and this origin they themselves accepted; modern students have thought they solved the question by tracing them back to a Celtic, Albanian, Semitic, Egyptian, Basque, or Armenian source. But the problem still remains a mystery. A strong argument is, however, afforded for their Turanian origin, that the Etruscans, like the Egyptians, the Lycians, the Chinese, and the nomad tribes of Northern Asia, buried their relatives in the house-sepulchre. The religion of all these races centred in a belief in the spirit world—in the conviction that the ghost of the departed still lived to all

Etruscan funeral urn of brown clay (most ancient period), in the form of an Etruscan dwelling or tugurium.

intents and purposes, still needed ghostly food, armour, horse, ornaments. Hence all that he prized or loved in his life was buried with him. A dwelling the exact counterpart of the abodes of the living, save that it was below the earth and they above it, was devoted to the uses of the dead, made of brown clay, built of solid stone masonry or hewn out of the tufa rock. Varro mentions the Etruscan annals existing in his time as having been written in the eighth age of Etruria, which is supposed to correspond to the fourth century of Rome. Two Latin writers, Valerius Flaccus and Cæcina, the latter a native of Volaterræ, wrote histories of Etruria, and the Emperor Claudius wrote in Greek his history of Etruria in twenty books, but all these are lost. The little we know therefore of the national history of Etruria previous to their wars with Rome is gathered from fragments and incidental notices in Greek and Roman writers, and is uncertain and obscure.

Veii was the first Etruscan city that fell by the Roman arms; Falerii and Fescennia next; Sutrium submitted; Cære and Tarquinii became the allies of Rome; and the Ciminus ridge, with its haunted forests, formed the boundary between Rome and Etruria. The Roman arms halted nearly a century before they passed that boundary. The total defeat of the confederated Etruscan forces at the Lake Vadimonis, in the year 444 of Rome, opened to the Romans access into the Etruria Transcimina. Volsinii and Vulcia fell before the slow but sure progress of their arms; the other cities, such as Arretium, Perusia, Volaterræ, Populonium, disguised their submission under the name of allies, but Etruscan independence was gone. This appears to have been a period of general corruption of manners, when all national spirit and independence became extinct; but wealth, luxury, and internal peace remained. The wars and proscriptions of Sulla gave a final blow to the existence of the Etruscans as a nation; their towns were destroyed, and their lands were given to military colonists. The proscriptions of Octavianus after the battle of Perusia completed the desolation of Etruria.

The name was revived by Napoleon I. in 1801 at the peace of Luneville as the kingdom of Etruria. In 1807 it became a province of the empire of France. In 1809 it was constituted the grand-duchy of Tuscany for Napoleon's sister Eliza and her husband. The Bourbon family, old grand-dukes of Tuscany, was restored in 1814 on the fall of the empire, was driven out in 1849, and restored by Austria in 1850; it was finally driven out in 1859, and the country added to Sardinia by popular vote in 1860.

The Etruscans divided their history into ten periods or *sæcula* of about 100 years each. Taking the tenth sæcula as beginning about 44 B.C., it has been calculated that Etruscan chronology commenced about 1050 B.C. The race was marked by large heads, clumsy limbs, and short thickset forms. The Phœnicians, the Greeks, and the Etruscans had until the third century before Christ the practical monopoly of the sea; and of the three rivals the last-mentioned were, during the most flourishing period of their history, second to none. In that lawless era of the world commerce went hand in hand with piracy. The Tyrrhene privateers were the terror of the western Mediterranean, and during Etruria's palmy days effectually paralyzed the colonizing expeditions of the Greeks.

The Rasennic religion was of a character whose cheerful side was completely subordinated to its more gloomy and horrible features. Furies, demons, evil genii, the god of Hades with his ministers of torture, in much more awful guise, number, and with more cruel attributes than their Greek equivalents, occupy the most prominent place, not only in the sepulchral paintings, where they might seem not out of keeping, but on vases and bronzes destined for more lively uses. Of the Etruscan gods, except Apulu (Apollo), Ercle (Heracles), and Charun, we should not be justified in ascribing to any a Grecian origin. Tinia, the supreme deity, ruler of the thunderbolt; Thalna, his wife; Menrva, the Shrouded Gods, Vejovis, Sethlans (Vulcan), Mars, Saturn, Vertumnus, the chameleon god; Phuphluns (Bacchus), Turms (Mercury), Turan (Venus), though most of them had their equivalent among the Romans or Greeks, were genuine Etruscan, or at all events Italian, divinities. The ruins of the Etruscan cities mark unmistakably the greatness of their resources and the height of civilization to which they had attained. The colossal battlements and fortifications, in many cases almost complete, surrounding cities no longer habitable on account of the miasma and foul airs arising from the unhealthy soil on which they were erected, tell not only of their architectural and mechanical knowledge, but also of their victories over the difficulties presented by nature. Wonderful skill they must have possessed in draining swamps and marshes, in building tunnels, and in constructing embankments and irrigation works. Though the Romans denied that they

were disciples of the race they ultimately ruled, yet practically they bore unwilling witness to their greatness, by their imitation of them in customs, manners, and dress. The Roman religion was deeply imbued with an Etruscan element. The colleges of augurs and seers were originally fetched from Etruria, and their members, even within historical times, were Tuscan. The majority of the Roman gods and goddesses coincide in name with the Etruscan; and this, though their attributes were Hellenized at an early date, is sufficient indication of their origin. The Tarquin dynasty must have had a considerable share in the introduction of Etruscan usages. Undoubtedly the fasces and axes, and perhaps the purple, were due to them, for these were likewise the Tyrrhene emblems of sovereignty. The more ancient Etruscans would not have borrowed either their gods or their regal insignia from the comparatively barbarian Romans. For plastic works in clay, terra-cotta, and bronze, Rome in early times was dependent on Etruscan artisans. The celebrated bronze wolf of the Capitol is of Etruscan workmanship, and the same legend of which it is the embodiment has been traced to Eastern Asia. Of Roman amusements the circus and its horse races, the pipe-player, and perhaps the introduction of music in general, were due to this great power of Northern Italy. It is not clear that the rudiments of Roman architecture were not derived from the same source. The drainage works and aqueducts which have earned for the engineers of Rome universal admiration were at most only developments of the results of Etruscan skill and science. Even the early military science of the future empress of the world was introduced by Tuscan conquerors or learnt from Tuscan enemies. And what more natural than that the beginnings of the Roman navy may have been indebted to Etruscan rather than to Carthaginian models? In truth before Rome was even founded the Etruscans were a great nation. They wrought the iron which they drew from the island of Elba, they cast bronze, and they made silver vases and gold ornaments; they engraved on stone, and sculptures of primitive art are found on their oldest monuments. They are supposed by many to have been the inventors of the arch at a very remote period; Tuscan masons employed it in constructing the Cloaca Maxima of Rome. They understood hydraulics, especially the art of filling up marshes by diverting into them the course of muddy streams, which is still practised with great success in Tuscany under the name of "colmate." The invention of the termini, or stones fixing the limits of property, is attributed to them. The rights of property, those of paternal authority, of testamentary disposition, of marriage, were all fixed by law and consecrated by religious rites.

The Etruscan language may be described as dead in the fullest sense of the word. Beyond a few words we know nothing for certain. Our difficulty is increased by the great degradation of the language which is observable in comparing the oldest nomenclature in inscriptions with the latest. From a musical language which gave full prominence to the vowel system, it seems to have descended by constant syncope to a harsh combination of consonantal sounds, and this latter character is imprinted even on words borrowed from the Greek. Thus Klytæmnestra became Klutmsta, Achilleus Achle, and Alkestis Alksti. The alphabet, substantially similar to the Phœnician and Greek, enables us to form sounds, and no more than sounds, out of the inscriptions that confront us on the sepulchral masonry, vases, and bronzes of ancient Etruria.

ETRUSCAN ARCHITECTURE. We have no remains of Etruscan buildings, but we can form some idea of their style from their town walls, their sepulchral monuments, and also from some of their cinerary urns in the shape of a dwelling. But the monuments which serve perhaps to throw most light on this subject are those discovered at Castel d'Asso, 5 miles south-west of Viterbo, where the rock forming one side of the valley facing the old castle is sculptured all along for more than a mile in the shape of so many fronts or façades of sepulchral monuments, the vaults themselves being excavated underneath. Such a tomb is the one at Veii, the dead hero

Etruscan tomb at Veii.

Tomb of slabs containing body and vases. Ancient Etruscan, from Campania, Southern Italy.

being buried within, together with all due personal ornaments, arms, furniture, and vases of different uses, as shown in the figure. These tombs, indeed, are the principal sources of those Etruscan vases and metal ornaments which are so much admired. These monuments, which represent a primitive style of Etruscan building, strike by their resemblance to the Egyptian style in its ruder and simpler form. In Campania smaller tombs, composed of slabs of stone somewhat after the manner of mediæval stone-coffins, occur not seldom. Their contents are similar to the others. Vitruvius, although he lived in an age when Etruscan art had undergone considerable alteration, characterizes their buildings as low, wide, with heavy top ornaments. What is now called the Tuscan order appears to have been a sort of rude Doric or derived Egyptian. If not the inventors of the arch, the Etruscans were certainly acquainted with it at a very early period, as shown in their cloacæ or drains. Such a cloaca has been discovered near Tarquinii, and the Cloaca Maxima at Rome is of Tuscan origin. Their skill in fortifying towns with walls and towers and ditches is attested by the Roman writers, and by the inspection of the remains of their walls. The use of large polygonal stones in the construction of walls was common to other Italian people as well as the Etruscans and primitive Greeks. In most instances, however, the Etruscans appear to have used rectangular stones, ranged in horizontal layers, and uniformly without any cement, as in the well-known walls at Fiesole, close to Florence.

ETTY, WILLIAM, R.A., the figure painter, was born at York, of humble parentage, in 1787. Shortly after finishing his apprenticeship with a newspaper printer in Hull, he proceeded to London, in 1805, where he got employment in a plaster-cast shop, kept by an Italian named Gianelli, near Smithfield. His first important production was a plaster "Cupid and Psyche," which received the approbation of Opie, and was the means of introducing him to the professor of painting in the Academy, Fuseli, who admitted him as a probationer. He afterwards studied under Sir Thomas Lawrence as a pupil for twelve months. On the death of his uncle, who bequeathed him a considerable sum, he was enabled to proceed on a tour to Italy, where he imbibed that taste for the Venetian colouring which he subsequently took as his aim in his frequent essays in the nude. To compare Etty with the great Italians were an absurdity, but he has considerable merit by comparison with the moderns, and was among the most painstaking of workers. His "Youth on the Prow and Pleasure at the Helm" at the National Gallery is perhaps his best work. He died in 1850.

ETYMOL'OGY, the science of words (Gr. *etumos*, true; *logos*, speech), in its largest sense may be divided into three parts, whereof the first classifies words into the parts of speech, the second treats of their inflexions, and the third of their derivation from other languages. The latter or philological view of the term etymology is the popular usage, the other two parts being relegated to the vague term grammar, and sometimes called its *syntax*. We may leave aside the INFLEXION of words, which is elsewhere treated of, and briefly pass in review the other divisions of the subject.

Classification of Words.—Words fall naturally into four classes :—

1. Names of persons or things, objective or subjective.
2. Words attributing qualities, states, or acts.
3. Particles of connection or relation.
4. Simple cries of emotion.

Of these the first class is the familiar one of NOUNS, including personal pronouns; the second comprises VERBS, ADJECTIVES (including possessive and demonstrative pronouns) and ADVERBS; the third contains PREPOSITIONS and CONJUNCTIONS; and the fourth INTERJECTIONS. Of these, nouns and pronouns may be either subjects or predicates, adjectives can be predicates only, and verbs are predicate and copula combined; the rest are, by themselves, incapable of being used either as predicates or as subjects.

Derivation of Words.—In the article ARYAN (with ARYAN ROOTS) and also in ENGLISH LANGUAGE, and in the articles on each letter as it heads its division of the alphabet, as well as in each important or curious word as it occurs, the chief points of the derivative history of words in English and its allied tongues are touched upon. The present article will therefore trace the main principles, leaving the details for those separate articles.

When all inflexional additions have been stripped from a word, what is left is called the *root*, or in older languages the *crude form.* But it is very usual to allow the simplest form of the word to bear the name of root. Thus *bear*, though not a crude form, is in common parlance held to be the root of *bairn* (bear-en, that which has been borne); and *spin* in like manner is the root of *spider*. No inconvenience arises from this convention, and much facility is gained by it.

SUFFIXES (or the removal of suffixes) are a fruitful source of etymological alteration in the form of a word. Thus the final vowel in the Sanskrit *dvara*, though retained in the Greek *thura*, becomes silent in Old English *dore*, and is lost in *door*.

PREFIXES are the second great source of additions to language, including with them *combinations of words.* The first are of very various languages, as *by*stander, *prop*inquity, *par*allel, where English, Latin, and Greek respectively add the signification of "near" to various roots; and the second are such words as *rainbow*, *rosebush*, *careful*, &c., often slightly modified in spelling as in the last instance. Composite words not yet fully acknowledged in their new agglutination are joined by a hyphen. Thus we say, *all-wise*, but *almighty*; *bucket-full*, but *spoonful.* Suffixes and prefixes are treated of in detail in separate articles. Sometimes, very oddly, the prefix alone remains, while the original word has been wholly lost. A familiar instance is the French *bas* (stockings), which once, as *bas de chausses* (lower hose), answered to the now obsolete *haut de chausses*, which long continued unaltered to stand for upper hose or breeches. The original hose (*chausses*) now remain only as the hose-feet, the *chaussettes*, Anglice *socks.*

"Etymology," says Dean Mansel very truly, "will in nine cases out of ten declare, not the present meaning of a word, but either one that has become obsolete or some secondary notion which may account for the imposition of the name, but which at no time formed, strictly speaking, any part of its signification." Nevertheless, although a man's parentage is a very unsure means for judging his character, it explains and justifies the judgment formed in the only rational method, by direct observation namely. So also with etymology. In the article ENGLISH LANGUAGE, one great source of richness of our tongue is pointed out to consist in the large number of nearly synonymous words we have of different derivations, and of slightly different connotations which each has picked up in its journey. Let us take as an example the really almost identical words *countryman*, *peasant* (French *pays*, country), *hind* (Old English *hine*, a field-servant), *swain* (Icelandic *sweinn*, a field-labourer), *rustic* (Latin *rus*, country), *churl* (Old English *ceorl*, small farmer), *clown* (Latin *colonus*, settler on public lands), and we see that though it is hard to find any original distinction, yet as they now stand they are scarcely alike. The "swain" of pastoral poetry would flush with anger if he were called a "churl," and yet the English *ceorl* was rather the superior of the Scandinavian *sweinn.* "Friends, Romans, peasants," would miss its object if Mark Antony had used the latter word in a persuasive harangue instead of "countrymen."

A still more glaring difference of connotation between

words of like meaning in their origin is given in *insolent* (Lat. *in*, not; *solens*, customary), *immoral* (*in*, not; *mores*, customs), *abnormal* (*ab*, away from; *norma*, rule), *enormous* (*e*, out of; *norma*, rule); for these four, now so diverse, are all of practically identical meaning in the Latin origin.

Another pitfall is that of apparent derivation, inducing the curious alteration in words called FOLK-ETYMOLOGY. Thus the French word for highway, *chaussée*, gets to be cause*way*, and the people rest content with ignorance of the "cause" satisfied with the "way." Lantern (Lat. *lanterna*) becomes lant*horn*, as its horn sides, while glass was yet a rarity, seemed to warrant. Yet this "horn" leaves "lant" quite inexplicable. Other examples are *beefeaters* for French "buffétiers" (attendants at the buffet or sideboard); Mussul*man* for "Mussulmaun;" *wise*acre for German "weissager," a soothsayer; *country*dance for French "contredanse" (*contre*, opposite — the dancers being in opposite lines), &c.

The true methods of etymology do not rest upon surface resemblance. The most ancient forms of English often show clearly the derivation of a word which would be almost unrecognizable in its present dress, and ancient forms of other languages are useful in the like degree. Beyond this we are gradually discovering general laws of transmutations of consonants and vowels, laws of development in language, so to speak, akin to the development theory in biology. The most important of these is GRIMM'S LAW, which is now the sheet-anchor of etymologists, and as such demands a separate account.

The last pitfall of the tyro in etymology is the tendency to look upon languages as derived from one another. Nothing, so far as English is concerned, is more false. It is true that we have many French, Latin, Greek, and other derived words in our tongue [see ENGLISH LANGUAGE], but beyond these there is a still larger number of words possessing roots common to English and to those languages which have by no means come from them; these words have descended into all the tongues alike from the common Aryan speech, which we are bound to assume. Even Sanskrit, the oldest language known, must not be regarded as the parent of all the other Aryan languages, for there are some peculiarities in Teutonic and in Græco-Latin speech which are evidently older than Sanskrit. So also Latin, in so many things the successor of Greek, yet in some points has retained forms which Greek has lost. This particular form of error has been peculiarly prolific of mistakes up to our own day.

We may conclude this article by tracing one root into its ramifications in English. Let us take the Aryan root √WID, with the sense of "to see," and hence to "know." This root we are sure nearly represents the primitive speech of the great Aryan or Indo-Germanic family, while yet it dwelt undivided in the plateau of Central Asia. [See ARYAN.] This root we find in Sanskrit as *vid-*, to know; in Greek as *id-* (anciently *vid* with the digamma) and *eid-*, to see and to know; in Latin as *vid-*, to see; in French as *voir*, to see, *vue*, sight; in German as *wissen*, to know; in Gothic and the earliest English as *witan*, to know. These six forms of the root give a crowd of English words, of which the following are the most important:—

Sanskrit, vedas (books of wisdom), vedantist. *Greek*, idea, ideal, ideology, &c.; idol, idolize, idolatrous, &c.; kaleidoscope, &c.; spheroid, ellipsoid, asteroid, &c. *Latin*, vision, visible, &c.; visor, provisor, &c.; visit, visitation, &c.; advise, revise, supervise, &c.; advice, device, &c.; provide, divide (these point to a lost Latin meaning of "know" as well as "see"); evidence, evident, &c. *French*, envy, envious, &c.; view, review, &c.; purvey, survey, &c.; guise, disguise, &c. *German*, wise, wisdom, &c.; wistful, &c.; wizard, &c. *Gothic*, wit, witty, &c.; wit, to wit, &c.; witan, the Old English assembly of wise men;" y-wis, twit, witch, bewitch, &c.; wicked, &c. The last seems far-fetched, but is perfectly authentic; a wicked man is one who has become *wicca'd*, made like a *wicca* or witch, and wicca in its older form is *witga*, the "knowing one." If the "&c." in the above be filled out, the list will be surprisingly ample, for "idea" and "idol" represent certainly ten words each, and other branches would count even more.

Pending the far-off completion of the great English dictionary of the Philological Society (the first part of which appeared in 1884, under the editorship of Dr. A. J. H. Murray), the best books on English etymology are Professor Skeat's excellent etymological dictionaries (London, 1883)—the smaller of which, an independent work rather than an abridgment, is within the reach of all; Earle's interesting and valuable "Philology of the English Language" (Oxford University Press, 1882); and Hensleigh Wedgwood's etymological dictionary.

ET'ZEL, King of the Huns, a personage in the NIBELUNGEN-LIED, as well as in other middle-age German poems and myths, is now usually considered to be no other than the famous ATTILA, whose historic personality is under this name enlarged and added to as seen through the mists of romance. See also BRUNHILD, CHRIEMHILD.

EUBŒ'A, EGRIPOS, or **NEGROPONT** is an island of the Mediterranean, lying along the coasts of Attica and Bœotia, from which it is separated by the Euripus, a very narrow channel, over which a bridge has been thrown, connecting the island with the mainland. It is 90 miles in length in a north-west direction, and 30 miles in extreme breadth; but in one part, between Aliveri Bay and Port Petries, it is scarcely 4 miles across from shore to shore. The only towns are Chalcis and Karystos; the former is situated where the island approaches nearest to the mainland, and the latter at the southern extremity of the island, at the bottom of a bay bearing the same name.

The island generally is elevated, and contains among its mountains some of the highest in this part of Europe. Mount Delphi rises on the eastern shore to the height of 5725 feet above the sea, and its summit is scarcely ever free from snow; Elias of Karystos, at the southern extremity, is 4606 feet high; Mount Khandhili, 3767 feet, and Telethrius, 3100 feet, are both on the western shore north of Chalcis. The general formation of these mountains is gray limestone, with much clay-slate. The level tracts on the island are not extensive. On the northern coast, opposite to Thessaly, is the fertile plain of Oreos, the ancient *Hestiæotis*. Between Cape Politika and Chalcis is the fertile plain of Egripos; and there are a few other small plains. To the southward the plains are generally cultivated with corn and olives, but those to the northward, called the Plains of Oreos, are more particularly devoted to the vine, from which a light red wine is made, which is the common beverage of the Greeks, and forms a staple article of the trade. Cotton is also planted to the northward.

The passage between Thessaly and Eubœa is called the Trikiri Channel, from the town of that name at the eastern entrance to the Gulf of Volo, and is about 4 miles in average width. In the Gulf of Talanda, so called from the town of that name on the Bœotian shore, there is an amazing depth of water under Mount Telethrius, where, for about 12 or 15 miles, there is no bottom with 220 fathoms within half a mile of the shore; but from this point the water shoals gradually towards Chalcis. Near the base of Telethrius there are hot springs, of the same kind as those at Thermopylæ, but more abundant. From Chalcis southward to Karystos there are only two villages, Aliveri and Stura, in the bays called respectively from their names. The bed of this part of the channel is level, but compared with the northern it is shallow; the general depth is from 35 to 40 fathoms.

The mountains are said to contain copper, and the

marble quarries near Karystos have long been famous (Strabo, p. 446). The soil favoured by the diversities of climate which such a variety of elevation affords is capable of yielding the productions of tropical as well as of more northern regions, and of supporting a much larger population than now occupies the land. The island abounds in sheep of an excellent breed. In the mountains are abundance of wild boar and deer, and the plains are overrun with hares and rabbits. Among the trees are the olive, oak, fir, chestnut, walnut, mulberry, and Oriental plane. In the whole island there is not a stream deserving the name of a river into which the smallest boat could enter, and the inhabitants generally supply themselves with water from wells.

The breadth of the Euripus, a part of the strait near Chalcis, is diminished by a rock in mid-channel, on which a fort is built, which divides it into two channels; that towards the mainland, though rather the broader, is only practicable for small boats, as there is not more than 3 feet of water at any time. Between the rock and the walls of Chalcis is a distance of 33 feet, and the least depth at the highest water is 7 feet. It is here that the extraordinary tides take place for which Chalcis was formerly so noted: at times the water runs as much as 8 miles an hour, with a fall under the bridge of about 1½ feet; but what is most singular is the fact that vessels lying 150 yards from the bridge are not in the least affected by this rapid. It remains but a short time in a quiescent state, changing its direction in a few minutes, and almost immediately resuming its velocity, which is generally from 4 to 5 miles an hour either way, its greatest rapidity being, however, always to the southward. The results of three months' observation, in which the above phenomena were noted, afforded no sufficient data for reducing them to any regularity.

About 506 B.C. Eubœa became a kind of dependency of Athens. But in 445 B.C. it revolted, and Pericles recovered possession of it: the towns of Eubœa were reduced to the condition of tributaries to Athens, and an Athenian colony was settled at Oreos in the territiory of Hestiæotis, the fertile plain on the north coast of the island. This island was of great importance to the Athenians; it furnished them with corn, and supplied them with horses. During the Peloponnesian War, after the defeat of the Athenians in Sicily, another general revolt of Eubœa took place, and the island placed itself under the protection of Lacedæmon, but afterwards returned to the Athenian allegiance when Athens had recovered its independence. Its subsequent history is of little importance, and it fell under Roman dominion with the rest of Greece.

In the dismemberment of the Eastern Empire by the Latins or Franks the Venetians obtained possession of Eubœa, which they called Negropont, a barbarous name, probably derived from the town of Egripos, a corruption of Euripus, built on the ruins of Chalcis, and from the word "ponte," meaning the bridge which united it to the mainland. The Venetians lost the island in 1470, when the Turks took the capital, Negropont, and massacred all the inhabitants. The Venetian doge and General Morosini blockaded it in 1688, but after a determined siege were obliged to re-embark with great loss. The people of Eubœa took part in the revolt of the Greeks against the Turks, and the island now forms part of the kingdom of Greece.

EU'CALYN, a sugar obtained by fermentation from melitose, or eucalyptus sugar. It is dextro-rotary and non-fermentable. The formula is $C_6H_{12}O_6$.

EUCALYP'TUS, a genus of Australian plants, consisting of lofty trees, with a volatile, aromatic, oily secretion in their leaves, and a large quantity of astringent resinous matter in their bark. They belong to the alternate-leaved division of MYRTACEÆ, and are distinguished from other genera by their corolla being absent, and the limb of their calyx consolidated into a hemispherical or conical cap, which is thrown off when the stamens expand.

This genus occurs in the Malayan Archipelago, but is chiefly Australian, and, together with the leafless acacias, gives a most remarkable character to the scenery. The species exist in great profusion, and form the largest trees in the forests of Australia.

No trees in the world so constantly or rapidly arrive at gigantic dimensions. They commonly attain a height of 200 feet, and instances are known of their having attained a height of 350 feet. Their timber is highly useful for domestic and other purposes; being so soft at first as to render the felling, splitting, and sawing up of the tree when green a very easy process, and when thoroughly dry becoming as hard as oak. Gum-tree is the universal name among the colonists for the Eucalyptus, and has arisen from the large quantity of an astringent gum-like juice, resembling gum-kino in its qualities, which all the species yield. The gum yielded by *Eucalyptus resinifera* is considered by druggists as not inferior to the kino which the Pterocarpus, or red Sanders-wood of India, produces. At Moreton Bay and in parts of Tasmania a kind of manna is yielded by certain species. Their bark is often extremely hard, whence some species, especially *Eucalyptus resinifera*, are called iron-bark trees by the colonists. The Blue Gum-tree and some others have the singular property of throwing it off in white or gray longitudinal strips or ribbons, which, hanging down from the branches, have a singular effect in the woods. The leaves, instead of presenting one of their surfaces to the sky and the other to the earth, as is the case with the trees of Europe, are often arranged with their faces vertical, so that each side is equally exposed to light.

Much attention has of late years been given to the medical properties of the Eucalyptus, and it is found to be an excellent remedy against the toxic effects of the miasmata of marshes in unhealthy districts. In Corsica and Algeria large plantations of them have been formed. They have also been very plentifully planted in the unhealthy Campagna around Rome, with remarkably salutary effects; and it is hoped in course of time that their influence will effectually banish the dangerous malaria, and render this district at all times of the year thoroughly habitable and healthy. There is no doubt that the great quantity of water absorbed by the Eucalyptus from the soil has the most beneficial effect in draining it. But besides this, it seems probable that much of the aromatic essential oil contained in the leaves is oxidized, and, as a result, peroxide of hydrogen is produced, which is a very active disinfectant. Several preparations are made from the tree, and are found useful in intermittent fevers, consumption, rheumatism, scrofula, &c.

EU'CHARIST. See COMMUNION.

EU'CLID (*Eukleidês*) is the name of two most distinguished Greeks, one a geometrician, the other a philosopher.

EUCLID OF ALEXANDRIA, the father of geometry, exists for us almost only in his famous collection of propositions and demonstrations. That a small work (as far as its mere size is concerned) should still be an excellent text-book in its subject, after sixteen centuries have elapsed since its writer's death, proclaims its author as a man of the highest genius. Euclid is believed to have been a Greek, but is only known as residing at Alexandria under the first Ptolemy (323–283 B.C.) Besides the immortal "Elements of Geometry," Euclid has left a fine musical treatise "On the Divisions of a String," the best existing explanation of the Pythagorean system of music. A divided rule being placed under a string (*i.e.* a MONOCHORD), Euclid shows the relation of the Octave, Fifth, Fourth, Third, &c., to the ground-tone of the string, and derives the whole laws of harmony and of the formation of scales

from the results obtained. Another fine treatise, but upon that directly opposite view of music which is due to Aristoxenus, and which admits modified intervals for the sake of greater smoothness in melody [see TEMPERAMENT], is also ascribed to Euclid by virtue of that well-known rule whereby everything tends to cluster round a great name; but besides the absurdity of a man advocating contrary systems, the most cursory reader can detect the work of the merely practical musician, yielding theory to what is pleasant to the ear, who wrote the "Introduction to Music," and the skilled geometrician, whose "Divisions of a String" look at music purely as a branch of mathematics. Further, we have a "Phenomena" (Astronomical), an "Optics," and a special treatise on "Reflected Light" by this consummate master. The accuracy and variety of Euclid's knowledge is wonderful even at this day. His works were collected and published complete in folio at Oxford, 1703. A characteristic anecdote of Euclid has provided the world with a proverb to be found in every civilized nation. After a demonstration by Euclid, which Ptolemy had failed to grasp, the king asked the man of science, "But could not geometry be made easy?" and met with the stern truth in reply, "O Ptolemy, there is no *royal road* to knowledge."

EUCLID OF MEGARA, the philosopher (450-380 B.C.), was a pupil of Socrates, and extended the new method of dialectics in a school which he founded at Megara after the death of his master in 399. Megara is only 20 miles from Athens, and many of Socrates' disciples followed Euclid thither. The enthusiasm which Socrates excited is shown in nothing better than in the perfectly authentic account of Euclid's connection with him. Although the disciple was a thoroughgoing Eleatic, and was perpetually being reproved by the master for over-subtlety or sophistry, yet he night after night risked his life to continue the contest in which he was always the vanquished. At this time Megara and Athens were at such strife that a decree of death existed against any inhabitant of Megara found in Athens; and Euclid had therefore to traverse most of the 20 miles by night disguised as a female, and leave Athens again before daybreak, in order to converse with Socrates. Plato and the chief Socratists took refuge with Euclid for a time during the persecution at the time of the great teacher's death, after courageously staying to bid him farewell (see the "Phædo" of Plato); and when Plato returned to Athens some went with him, others remaining with Euclid. His teaching, as represented by Diogenes Laertius, consisted chiefly in the lofty doctrine that God is the only good; He is the *One*, the *Unalterable*—all else is imperfect, partial, and transitory. God is to be regarded in various aspects, sometimes as the supreme *Wisdom* (Providence), sometimes as the supreme *Intelligence*, sometimes as the *Divinity* simply. But nothing else than God can be said truly to exist. This conception of God as the supreme good is eminently Socratic. Socrates always attacked the premises of his opponent in debate; Euclid, on the contrary, always attacked his conclusions.

EUDIOM'ETER, an instrument invented by Dr. Priestley, and originally employed by him in ascertaining the purity of atmospheric air obtained from various places and under different circumstances. The use of the eudiometer, termed eudiometry, has been extended to all gaseous mixtures, especially for determining the amount of oxygen which they contain.

The principle upon which the use of the eudiometer depends, so far as atmospheric air and oxygen gas are concerned, is that of exposing them to the action of some substance, whether solid, fluid, or gaseous, which, on account of its affinity for oxygen, combines with it and leaves the gas with which it is mixed unacted upon.

The eudiometer invented by Dr. Priestley was extremely simple. He filled a phial with water, and displaced the water with the gaseous mixture to be examined; the volume of this being noted, it was transferred into an air-jar. An equal volume of nitric oxide was added to it, and they remained together a few minutes. When this part of the process was over the gas was transferred to a graduated glass tube. After noting the volume of the gas, the result was expressed in measures and decimal parts; thus, when equal volumes of common air and nitric oxide were mixed, and they afterwards occupied the space of one volume and two-tenths, Dr. Priestley, in speaking of the air so tested, said the measures of the test were 1·2, or the standard of the air was 1·2.

Numerous attempts have been made to render the eudiometrical application exact and certain by Cavendish, Fontana, Ingenhouz, Sardinani, Dalton, Gay-Lussac, Henry, Thomson, Davy, and others. The eudiometer of Scheele was a graduated glass tube containing a certain volume of air, which was exposed to a mixture of sulphur and iron filings made into a paste with water. De Marté, instead of using sulphur and iron, employed a solution of sulphuret of potassium prepared by dissolving sulphur in a solution of potash. Guyton employed sulphuret of potassium also in his eudiometer, but he used it in a solid state, and applied heat to expedite its action. The eudiometer of Seguin is a glass tube filled with and inverted in mercury; a small piece of phosphorus is put under the open end of the tube, and by its lightness it immediately rises to the top of it, where it is melted by the approach of red-hot iron. A measured portion of the gas to be examined is then passed into the tube; the phosphorus inflames on each addition of the gas, and the mercury rises, owing to the condensation of the oxygen. The quantity of the residual gas is determined by transferring it into a graduated tube, and the difference between the quantity submitted to experiment and that left after it indicates that of the oxygen absorbed. Berthollet also employed phosphorus in his eudiometer; but instead of heating it, as in the method described above, he allowed combination to take place between it and the oxygen by slow combustion. Dr. Hope, Dr. Henry, and Mr. Pepys employed a eudiometer in which the test liquid was either a solution of iron impregnated with nitric oxide, or a solution of sulphuret of potassium. Volta's method of determining the quantity of oxygen contained in gaseous mixtures is by means of combustion with a known volume of hydrogen gas; for it having been ascertained that when a mixture of oxygen and hydrogen gas is fired one-third of the diminution is owing to the condensation of oxygen, it remains for us only to observe the measure of the contraction of volume to ascertain that of the oxygen which was present. Various modes of effecting this have been devised by Volta, Mitscherlich, Dr. Ure, &c.

Dobereiner has suggested a eudiometrical process, founded on his curious discovery of the property which spongy platinum possesses of causing the combination of oxygen and hydrogen gases. In this eudiometer the combination occurs without explosion, and yields results of great accuracy. Dobereiner found that when the spongy platinum was mixed with certain substances, so as to prevent its immediate and explosive action, it caused the oxygen and hydrogen to combine with moderate rapidity. Dr. Henry and Dr. Turner employed modifications of this process. Pyrogallic acid is now generally employed for the absorption of the oxygen where explosion with hydrogen is inadmissible. Eudiometers of a complicated and elaborate form are largely used in the volumetric analyses of gases.

EUDOX'IAN HERESY, THE, was the opinion promulgated by Eudoxius, a patriarch of Antioch in the fourth century, that the Son possessed an independent mind, as apart from that of the Father, and that it was possible, if not indeed probable, that variance might exist between them.

EUDOX'US of Cnidus, the famous city of Asia Minor, was one of the most distinguished men of ancient Greece. He was equally celebrated as an astronomer and a geometrician; he exhausted the limited medical knowledge of the time, and enjoyed great repute as a legislator. He flourished about 350 B.C., as we know from the Roman adoption of his improvement of the calendar in about fifteen years from that date. The Roman year had been very irregular, varying from 304 to over 366 days, and farmers were compelled to work more according to the seasons; the "farmer's year" was the Egyptian solar year of 365¼ days as arranged by Eudoxus. He derived his philosophy from studies under Plato himself, and his astronomical and medical knowledge from the priests during a residence in Egypt. Strabo at the commencement of our era saw and admired the then existing observatory of Eudoxus. To this discoverer is assigned the first coherent doctrine of the true easterly motions of the sun and moon, and the motion of the planets, and the first account of the stars as distinct from them. Aratus in his "Phænomena" is held to have done little more than versify the existent works of Eudoxus.

EUDOXUS of Cyzicus (about 130 B.C.), one of the early navigators and geographers, migrated to Egypt, and served under Ptoleny Euergetes in journeys to India. He sailed to Spain round Africa from Egypt (Red Sea), but vainly endeavoured to accomplish his return by that rout. The usual course was naturally from Alexandria, along the Mediterranean.

EUER'GETES. See PTOLEMY.

EUGÈNE, PRINCE, the victor of seventeen pitched battles with no defeat of importance—the greatest general, in fact, except our own Marlborough, of his time—was by birth a Frenchman. François Eugène de Savoye was born at Paris in 1663, his father being the Count of Soissons and his mother the celebrated Olympia Mancini, niece of Cardinal Mazarin. The Count of Soissons was grandson of the Duke of Savoy. As the countess his mother fell into disgrace with Louis XIV., and was forced to fly to Brussels, Eugène's prospects at the court of the Grand Monarque were blighted. He had studied for the clergy, and was known by the nickname of "Le petit abbé," but soon found his taste, in spite of a somewhat weakly body, lay towards the profession of arms. When he applied respectfully for a company in a regiment of cavalry Louis somewhat contemptuously refused him. Eugène left France in 1683 with an undying hatred. His mother's bitter enemy, the minister Louvois, said triumphantly, "He shall never return," but the youth retorted, "I shall though, and that with arms in my hands!" Never was a promise so religiously kept. Eugène went direct to Vienna, was received with open arms by the emperor, and sent on a trial campaign against the Turks. His daring and his capacity at once warranted his being put in command of a regiment. All his life he was perfectly reckless of his own safety. During his career he was wounded no less than thirteen times on the field of battle, sometimes very severely indeed. By the time he was twenty-five he had become a general, and commanded as such at the first siege of Belgrade in 1688.

In 1690 Prince Eugène went to Savoy as ambassador from Austria, and induced the duke to take arms against France. At first this brought disaster upon his relative, but as soon as the prince himself took command his military genius began to display itself, and his campaign of 1691 was the first of the series of almost unbroken victories which continued throughout his life. In three campaigns he drove the French out of Savoy, and in return penetrated into Dauphiné. Probably the illness of the Duke of Savoy, which necessitated a retreat, alone saved France from much greater disaster. Louis XIV. was so alarmed that although some years before a decree had been issued condemning to perpetual exile all Frenchmen continuing to serve in foreign armies he nevertheless offered Eugène secretly the baton of a marshal of France and a handsome pension—gifts only offered to be scornfully thrown back by the prince. Savoy, however, being gained over by like arts, Austria had nothing more to do in that direction for the time, and Eugène was sent against the perpetual enemy, the Turk. He gained the splendid victory of Zentha on the Theiss over the sultan in person (1697), and after some further campaigns reduced him to sue for peace at Carlowitz, 1699. Of this surprising Zentha victory the historian of Frederick the Great says (vii. 6), "Eugène's crowning feat; breaking of the Grand Turk's back in this world: who has staggered about, less and less of a terror and outrage, more and more of a nuisance growing unbearable, ever since that day." In 1701 he was again in Italy, enjoying success after success over the French. In vain did Marshal Villeroi replace Catinat: he was only driven to shut himself up in Cremona. Here he was attacked by night by the prince. Villeroi was taken prisoner, but Prince Eugène could not hold good his brilliant assault. Vendome replaced Villeroi, and got so far as to be able to dispute the victory of the sanguinary fight at Luzara (1702).

The famous Marlborough (Bavarian) campaign began in 1704. The two commanders had unfeigned respect for each other, their habits and modes of strategy were harmonious, and some of the best examples of the military art are found in their combined victories. The war was still, as with Eugène's previous campaigns, that of the Spanish Succession; for as the grandson of Louis XIV. had assumed the crown of Spain as Philip V., the imminent danger to Europe from this concentration of power in the Bourbon family had united Austria (who claimed the succession herself), England, and the States of Holland in one "grand alliance" against France. Blenheim, 1704, saw one of the greatest triumphs England ever gained fall to Marlborough seconded by Eugène. Unfortunately the success of Vendome in Italy in the prince's absence caused his instant recall, greatly to the annoyance of himself and of Marlborough. At Cassano, 1705, Prince Eugène was badly wounded, and his army, left without a leader, was severely handled; but he took a splendid revenge in his raising the siege of Turin with 30,000 men, though the French under the Duc d'Orléans numbered no less than 80,000 (1706). Here again he was badly wounded, and fell into a ditch, but continued to direct the fight. Italy was irrecoverably lost to France, and Prince Eugène himself was proclaimed governor of Lombardy, 1707.

His second campaign with Marlborough was in the Low Countries. Here the allied generals, each ably assisting the other, gained the victory of Oudenarde in 1708 over the Duke of Vendome, and took Lille soon after in spite of the heroic defence of Marshal Boufflers. Tournay fell next year, and though Villars was entrenched at Malplaquet in an apparently impregnable position, Marlborough and Eugène, with a fearful loss (20,000 hors de combat against 8000 of the French), drove him before them in a manner truly surprising. But such a victory is too costly: Malplaquet ruined their power for active campaigning for the rest of the year; as for the Dutch infantry it had in fact entirely disappeared. In 1710, however, the prince took successively Douai, Bethune, and Aire. The next year saw Eugène in London pleading hard with Queen Anne not to carry out her threat of withdrawal from the alliance. But as Charles VI., the claimant of the Spanish crown, had now succeeded to the throne of Austria, it is manifest that his victory would give the Austrian house the preponderance England had dreaded in the case of France. In vain Marlborough pleaded, and the lords were on his side—new peers were created till there was a majority. At the same time, in December, began the duke's prosecution by the Commons on the charges of peculation and embezzlement, which, as in the case of Lord Bacon, made a great man a criminal for doing only what was the acknowledged

custom (truly, a very bad one) of his office. Eugène and the Dutch continued the war alone, but the latter were defeated at Denain (1712) before Eugène and the Austrians could get to their assistance, and withdrew in their turn from the alliance. Eugène still tried even single-handed for a year or two to cope with France, but he was magnanimous enough himself to advise his master the emperor to make peace as soon as he found his strength insufficient (peace of Rastadt, 1714).

In 1716 he was once more in the field against the Turks, whom he utterly defeated at Peterwardein. The next year saw the grand victory of 40,000 men under this great general against a force of at least six times their number. In 1718 the Turks again sued for peace at Passarowitz.

In 1720 began the long weary years of diplomatic business over the promulgation of the "Pragmatic Sanction" by the emperor, and its acceptance by the various European states—destined to fail so fatally, notwithstanding all the pains spent upon it; and Eugène, as Carlyle tells us in his humorous account of the whole transaction, bore much of the brunt of this work. "Eugène dictated and signed his name (in three languages, 'Eugenio von Savoye') to these square miles of dull epistolary matter—probably taking Spanish snuff when he had done. For he wears it in both waistcoat pockets; has, as his portrait still tells us (mouth always open), given up breathing by the nose. The bright little soul with a flash in him as of heaven's own lightning, but now growing very old and snuffy." ("Frederick," v. ii.) Such a portrait shows us in masterstrokes Eugène as he was in those days. The prince succeeded in his dreary task, but we fancy welcomed his appointment to the army of the Rhine in 1733 as a relief. A quarrel with France had arisen over the election to the throne of Poland, and brought about the resumption of hostilities. Eugène was now seventy, and the campaign, though clever, is chiefly remarkable in that Frederick the Great, as he told the Prince de Ligne, first saw service in it. He laughingly pointed out that he, the arch-enemy of Austria, had won his spurs under her banners; and spoke with the truest respect of Eugène as the greatest captain of the age. Peace was signed during the year, and at last this warrior was suffered to repose. Prince Eugène died at Vienna in 1736.

He had amassed a considerable fortune (which he left to the Princess of Savoy, his niece), but always used his position nobly. His protection of Rousseau, and the large collections of scientific and artistic objects which he found time to make, show him to have been superior to his age in other respects than as a captain. The so-called "Vie de P. Eugène, écrite par lui-même," is really by the witty Prince de Ligne, and is a good deal embellished. It is fairly accurate, however, and is most entertaining.

EUGE'NIA, a genus of plants of the order MYRTACEÆ. The genus contains over 700 species, but, according to Bentham and Hooker, these will probably be reduced to about 500. It is confined to the hot and tropical parts of the world, and extends from the Moluccas and Ceylon to Silhet and the foot of the Himalyas. Eugenia is characterized by the four-parted calyx; the petals, of the same number, inserted on the calyx; stamens numerous; ovary two or three celled, with several ovules in each; fruit inferior, having one or two cells, with one or two seeds.

The most remarkable species of this genus, and one of the few which it is necessary to notice, is the Allspice, Pimento, or Bay-berry Tree (*Eugenia Pimento*). It is a native of South America and the West Indian Islands, especially Jamaica, and from being cultivated there is often called Jamaica pepper. The tree is very handsome, often 30 feet high, and much resembles the clove tree in the form and appearance of its leaves as well as in habit. It is cultivated with great care in Jamaica, and abounds on the hills on the north side of the island. The trees are formed into regular walks, and begin to bear when three years old, but are not in perfection until they have been planted seven years. They thrive best in rocky lands, or in a rich soil having a gravelly bottom. A single tree has been known to yield 150 lbs. of the raw fruit, or 100 lbs. of the dried spice; but the crop is uncertain, and plenteous perhaps only once in five years. The tree has been introduced into and flourishes in the southern parts of India. The berries, being the valuable part of the tree, require care in gathering as well as drying. Their fragrant odour and flavour are thought to resemble a mixture of cinnamon cloves, and nutmeg—hence the name of Allspice. The leaves and bark also have warm aromatic properties.

Eugenia Michelii is a Brazilian species cultivated in Martinique, whence it is called *Cerisier de Cayenne*, as it yields a small edible fruit.

EUGE'NIC ACID or **EUGENOL**, an oily acid obtained from oil of cloves. It is also found in oil of cinnamon. It is a colourless oil, of specific gravity 1·076, boiling at 242° C. (467° Fahr.) It has a strong odour and taste of cloves. The formula is $C_{10}H_{12}O_2$. It forms an ether called eugenic ether ($C_{12}H_{16}O_2$), and a number of well-defined salts called eugenates.

EUGE'NIUS was the name of four popes.

ST. EUGENIUS, a Roman, was elected in 654 in the room of Martin I., whom the Emperor Constans II. had banished. He continued the contest begun by Martin against the Monothelite heresy, favoured by the court, till his death in 657.

EUGENIUS II., styled "father of the people," was also a Roman. He reigned from 824 to 827. He ascended the throne of St. Peter in a time of such abuses, including a dispute over his own election, that the Emperor Louis the Good sent his son Lothaire to Rome to reform them. At the same time Eugenius was forced to acquiesce in the emperor's settlement of the right of electing the popes as belonging to the nobles of Rome, and in the demand that the pope before confirmation of his election should swear fidelity to the representative of the emperor. A general council was held at Rome for these and other matters.

EUGENIUS III., of Pisa (1145-53), was abbot of the Cistercians and a disciple of St. Bernard. St. Bernard was the great advocate of the temporal sovereignty of the popes, and it was quite as his friend that Eugenius was elected. He is remarkable as possessing the respect of the Romans for his private virtues while they steadily resisted his authority as sovereign, and refused him permission to reside at Rome. When he was elected Arnold of Brescia was preaching the liberty of the state at Rome, and the senate went so far as to shake off their allegiance to the pope, restore the old constitution of the republic, and elect a "patrician." Eugenius had to retire to Viterbo and thence to France, where he held councils at Rheims and elsewhere, in 1148. In 1149, by the help of Roger of Sicily, he entered Rome by force of arms, but had to leave it again almost at once. The Emperor Barbarossa was about to restore him to his authority when he died, 1153. The Romans buried him in the Vatican with every mark of personal respect. In his reign Gratianus, a Benedictine monk at Bologna, drew up his code of canon law (Decretum Gratiani), largely extending the claims of the papal authority in ecclesiastical matters.

EUGENIUS IV. (Gabriele Condolmieri, of Venice), 1431 to 1447, had a stormy and chequered pontificate. His predecessor, Martin V., had summoned the famous Council of Basel, and this council met in 1431, and continued to sit year after year, growing more and more anti-papal in its tone. Its objects were the reconciliation both of the Hussites and of the Greek Church, and the usual "reform of the church." Eugenius, originally a Celestine monk, a hard and narrow dogmatist and a firm hater of heretics, was shocked to learn that the council was preparing to treat with the

Hussites. He therefore dissolved the council and summoned another for Bologna in 1433. But the council disregarded the authority of the pope, and backed up by the emperor even summoned him to appear before it. Of course the summons was disregarded, whereupon the council declared the pope guilty of schism. Eugenius yielded so far as to withdraw his bill of dissolution. In 1434 he had to fly from Rome to Florence in disguise, for the Colonna family, which on his accession he had despoiled of its possessions on an accusation that they were improperly acquired through the last pope (who was a member of the family), had regained power, and held Rome at its mercy. In 1437 Eugenius desired the council to come to Ferrara to meet the Greek emperor and patriarch, who were coming to discuss the terms of reunion with Rome as the price for assistance against the Turk, now at their doors. The council not only refused, but once more summoned the pope before it, on charges of simony and schism. Eugenius retorted by excommunicating the fathers of Basel, and annulling their decrees, and summoned a council of his own, while the Council of Basel at the same time formally deposed Eugenius and elected Amadeus of Savoy in his stead as Felix V. The Council of Ferrara met 1438, and the emperor John Palæologus II., with the patriarch of Constantinople and many Greek bishops, &c., attended it. The plague drove the council afterwards to Florence. After discussions of minute theological differences which threatened to become interminable, a solution was arrived at (1439) which each party understood in his own sense, and which was repudiated by the Greeks so soon as they returned home and understood the use the Romans were making of their concessions. The attempt at reunion made in this unwise manner has apparently for ever driven the "Orthodox" and the "Catholic" churches asunder. In 1443 the Council of Basel separated, promising to meet again later, and the King of Aragon forced an entry into Rome for the pope, whose fortunes began to mend; and in 1447 Æneas Sylvius Piccolomini (afterwards Pope Pius II.), by transactions which will not bear examination, and which certainly involved alteration of state documents among other evil practices, induced the whole of Germany to declare against Felix V., the anti-pope. But Eugenius lived only long enough to sign the treaty of reconciliation with the Emperor Sigismund, and was candid enough to admit with his last breath that it had been better had he spent his life among his early companions of the cloister. As for the anti-pope and the Council of Basel, they submitted to Nicholas V., the legitimate successor of Eugenius, and Nicholas in return ratified the acts of the Council of Basel.

The conduct of Eugenius is in most important particulars of his life quite indefensible. If we cannot fairly charge upon him the acts of Æneas Sylvius, yet the bringing of the Greek emperor to Ferrara, as if to a council of the whole church, and the whole conduct of those intricate and somewhat unworthy negotiations between the churches, are not honourable in modern eyes, and met their just reward in failure. So also the shameful advice to break their oaths which Eugenius gave to the Poles and Hungarians, then in treaty with the Turks, though at first it gained a temporary success for the Christians, only resulted in their utter defeat at Varna (1444), with great slaughter (which included the King of Poland and the papal legate), and left all Europe in abject terror at the rapid progress of the Turkish arms.

EUHE'MERISM, the system of explaining away myths and miracles by natural causes, in order to banish the supernatural element from religion; derived from the Sicilian philosopher Euhemerus, who taught this doctrine at the court of Macedonia about 316 B.C. According to Euhemerus the gods were originally great and good heroes, whose powers and virtues had become magnified as seen through the mists of time. A like explanation of the miracles in the Bible is offered by a certain school of biblical criticism, but is not now in much favour. It is felt that in most cases euhemerism offers more difficulties than it reconciles, and the questioner must choose usually between belief or denial.

EU'LER, LEONARD, one of the first of mathematicians, was born on the 15th of April, 1707, at Basel, in Switzerland. His father, Paul Euler, was the Calvinistic pastor of the neighbouring village of Riechen. Euler studied at Basel University under John Bernouilli.

The Academy of Sciences at St. Petersburg was then rising under the patronage of Catharine I., who invited several philosophers to her capital. On the retirement of Daniel Bernouilli, Euler was appointed professor of mathematics under Peter I. in 1733. He found it convenient at this time to apply himself intensely to study and the production of scientific essays, not more from his natural ardour for the sciences and the incentive of an increasing reputation, than from a desire to avoid the political intrigues which, under a suspicious and tyrannical minister, then agitated Russia. This is the period of his clever but shallow researches in music. [See CONSONANCE.] Upon the fall of Biron he gladly accepted an invitation from the King of Prussia to visit Berlin, and assist with his advice on certain matters involving calculations.

The Princess of Anhalt-Dessau, being desirous to profit by the presence of Euler in Berlin, requested to be favoured with instruction on the known facts in the physical sciences. To this wish he fully acceded on his return to St. Petersburg in 1766, by publishing his celebrated work, "Letters to a German Princess" (1768–72).

In consequence of his unceasing application to study, Euler had the misfortune to lose the sight of one eye in 1735, and in 1766 that of the other; he, however, continued his valuable researches, some of his family acting as amanuenses, and his powers of memory are said to have been wonderfully increased even in his old age. He died in 1783. The number of Euler's printed works is enormous, and many others are still only in manuscript.

EU'MENES of Cardia, a town in the Thracian Chersonese, was an important actor in the troubled events which for a long period followed the death of Alexander the Great. Being early taken into the service of Philip of Macedon, he served him for seven years, and Alexander for thirteen, in the confidential office of secretary. He also displayed great talent for military affairs throughout the Persian campaigns, and was appointed governor of Paphlagonia and the coasts of the Euxine at Alexander's death, B.C. 323. He is the only one of Alexander's officers in whose conduct any appearance of gratitude or disinterestedness can be traced. When war broke out between Ptolemy and Perdiccas, in 321, he was appointed by the latter to the chief command in Asia Minor to resist the expected invasion of Antipater and Craterus. The latter he defeated, but the death of Perdiccas in Egypt threw the balance of power into Antipater's hands. The task of reducing Eumenes was assigned to ANTIGONUS, by whom he was defeated and put to death, B.C. 315. Eumenes was an admirable soldier, brave, full of resources, and of unbroken spirits. Those parts of Diodorus Siculus (book xviii.) which relate to him, and Plutarch's Life, will be read with pleasure by all who are fond of military adventure.

EUMENES, King of Pergamus (B.C. 197–159), was son of Attalus, king of Pergamus, and was a hearty ally of the Roman republic. To reward him for his support against Antiochus, the grateful Romans gave him Mysia, Lydia, Phrygia, and the Thracian Chersonese, raising him from the condition of a petty sovereign to that of a powerful monarch. Pergamus became a great city under him, with a library rivalling that of Alexandria.

EUMEN'IDES (Gr., the kind goddesses), a name given to the Erinyes or Furies, whose business it was to

avenge dreadful crimes, disobedience to parents, perjury, murder, &c., upon earth. They were called the kind goddesses as the Euxine was called the "hospitable sea," in direct opposition to the fact, lest they might be provoked to anger by the insult of naming their true character, and necessarily in the very name appearing to condemn it. Æschylus calls them "Daughters of Night." Their names were Tisiphone, Alecto, and Megæra. Later representations depict them as serious, grave maidens, but the original type is more nearly that of the Gorgon, with smoky hair, sometimes winged, usually black-robed. Colonos, near Athens, had a grove sacred to the "nameless goddesses."

EUMOL'PIDÆ, among the Greeks, the name of an important order of priesthood, whose duty it was to superintend the Eleusinian festivals. The name was derived from Eumolpus, king of Thrace, who was appointed priest of Ceres by Erechtheus, king of Athens; and the sacred office remained in his family for 1200 years.

EUNI'CIDÆ is a family of marine worms belonging to the order ERRANTIA, leading a wandering predaceous life. The body is very long, and the segments that build it up are exceedingly numerous and narrow. The head is distinct. The organs of mastication attain in these animals the highest degree of development. The eversible pharynx, the so-called proboscis, is armed with several pairs of horny jaws, articulated with each other, and approximated beneath so as to rest on a sort of under lip of a similar horny texture. The first and second segments have no lateral outgrowths (*parapodia*) or feet. The others have feet composed of only one branch, and furnished with two cirri, and with spines as well as bristles. These latter are both simple and compound. The branchiæ are arranged along the back in the form of comb-shaped filaments, whose colours vary in hue according to the habitation of the worm. The eyes are sometimes very distinct and two in number; at others they are scarcely discernible. The antennæ vary in number and size, in some species being long, and five, seven, or even nine in number; while in others they are short, and only two or three. Other species again have none at all. The species are not very numerous. Some species of the genus Eunice attain a great size, *Eunice gigantea* attaining a length of 4 feet, and a British species, *Eunice sanguinea*, being 2 feet in length.

EUNO'MIUS, one of the chiefs of the Arian sect during the greater part of the fourth century, was a native of the town of Dacora, in Cappadocia. At Antioch he was ordained a deacon, and about 360 he was elected bishop of Cyzicus. The divinity of Christ was at this period the all-absorbing subject of ecclesiastical controversy. In defence of unmodified Arianism Eunomius exerted a high degree of natural ability, asserting the impossibility of two principles in a simple substance, one of which is generated from the other and exhibits the relation of a son to his father. The divine essence, he said, is necessarily characterized by oneness and indivisibility; the persons of the Godhead, like the divine attributes of wisdom, justice, mercy, &c., are merely the names of ideal distinctions of the one Supreme Essence, as considered in its different relations with exterior objects, and it is a contradiction and manifest absurdity to suppose this simple essence to consist of a plurality of principles or parts. Eunomius still acknowledged a Father, Son, and Holy Spirit, but the Father as supreme, eternal, and distinct; the Son as generated from the Father, and the Holy Spirit as generated from the Son. Eunomius experienced a great severity of persecution without swerving in any degree from the Arian tenets with which he commenced his career. He was thrice banished from his episcopal see; first by Constantius to Phrygia, then by Valens to Mauritania, and lastly by Theodosius I. to the island of Naxos; however he died in peace, at a very advanced age, in the year 394. Most of his works are lost.

EU'NUCH (Gr. *eunuchus*, a castrated male; literally, one who has the care of a bed). It was usual among the Persians to intrust the care of their wives and daughters to such persons. Tavernier tells us that in the kingdom of Bhutan 20,000 eunuchs were annually made in his time to sell to other nations; and the seraglios of the East are principally served and guarded by them to the present day. The Christian emperors of Rome forbade the practice of making eunuchs. In Italy, however, till a recent period, it was kept up on children intended to supply the operas and theatres of Europe as singers. The Council of Nice condemned those who from excess of zeal made eunuchs of themselves. Persons so mutilated were not admitted into holy orders.

EUON'YMIN, the active principle of the *Euonymus europeus*, or spindle-tree. It is used in medicine as a cholagogue. It is a crystalline resinous substance, soluble in ether and alcohol, but insoluble in ether.

EUON'YMUS. See SPINDLE-TREE.

EUPATO'RIA, a seaport town situated on the western side of the Crimea, 38 miles W.N.W of Simferopol, and 34 from Sebastopol. It was formerly known as Koslov, when subject to Turkey; but now it belongs to the Russian Government of the Taurida. It has a large harbour, a custom-house, hospital, and Tartar school; and a considerable trade is carried on. During the Crimean War it acquired some celebrity, as being the place near which the allied troops of England and France effected a landing, and which afterwards became their great military depot.

EUPATO'RIUM, a genus of plants belonging to the order COMPOSITÆ. *Eupatorium cannabinum* (hemp agrimony) is a native of Europe, and is mostly found on the banks of streams. It is a common plant in the British isles. The stem is about 3 feet high, and has a slightly aromatic smell. The whole plant is bitter, and was formerly employed in medicine as a tonic and febrifuge. An infusion of this plant is said to be the common medicine of the turf diggers in Holland against the ulcerations and diseases of the feet and legs to which they are subject. The expressed juice, when taken in large quantities, produces both vomiting and purging. *Eupatorium perfoliatum* (thoroughwort) is a native of North America, in meadows and boggy soils. All parts of this plant are intensely bitter, and a decoction of the leaves has been recommended by American physicians as a valuable tonic and stimulant, and used as a substitute for Peruvian bark in the cure of intermittent fever. In large doses the infusion or decoction of the whole plant is emetic, sudorific, and aperient. It is used with advantage instead of the infusion of camomile flowers in working off emetics. *Eupatorium Ayapana* is originally a native of South America, on the right bank of the river Amazon, from whence it has been introduced into the East Indies. An infusion of this plant is used in Brazil as a diuretic and diaphoretic. It has also been employed as an antidote against the bites of venomous serpents and insects. Other species of Eupatorium possess medicinal properties. *Eupatorium aromaticum* and *Eupatorium odoratum* have very fragrant roots; *Eupatorium perfoliatum* and *Eupatorium rotundifolium* have been employed in renal diseases and in consumption.

EU'PHEMISM is simply, as its original meaning in Greek imparts, a softened expression of an offensive phrase. The "domestic institution" of America was a decided euphemism for "slavery."

EUPHOR'BIA, a genus of plants giving its name to an extensive and important order, EUPHORBIACEÆ. The species have either a common leafy appearance, or they are nearly leafless, with their stem excessively succulent, so as to resemble Cacti. Those with the former character are natives of most parts of the world, and are the only kinds found in Europe. The succulent species chiefly appear

in the hottest and driest countries. Barren uncultivated places in the plains of Hindustan, and the arid regions of Asia and the north of Africa, are their favourite stations; in the Canaries, on volcanic soil, *Euphorbia canariensis* forms great bushes with arms like candelabras. From Cacti, which some of these plants much resemble, they are readily known by their spines, when they have any, not growing in clusters, and by their emitting, when punctured, an abundant discharge of milky juice. This in a concrete state forms what is called the gum-resin, or rather resin, called Euphorbium, an acrid, corrosive, most dangerous drug, principally furnished by *Euphorbia officinarum*, *Euphorbia antiquorum*, and *Euphorbia canariensis*. The same properties exist in the herbaceous leafy species, diffused in some, concentrated in others. *Euphorbia Lathyris*, a common weed in cottage-gardens, where it is called caper-spurge, yields from its seeds an oil of the most violent purgative nature. In this genus the flowers are collected together within a cup-shaped organ, the involucre, one female flower in the centre, consisting of an ovary alone; the others are male flowers, consisting each of a single stamen. Thus each collection of flowers looks like a single flower, and the involucre like a perianth, but each stamen can be seen to be jointed to a stalk with a scale at the base. The fruit consists of three single-seeded carpels.

EUPHORBIA'CEÆ, an order of plants, with unisexual flowers and tricoccous fruit, belonging to the MONOCHLAMYDEÆ. Jussieu placed them among his diclinous dicotyledons; nevertheless there are many strong marks of resemblance between them and malvaceous, celastraceous, and even elæagnaceous plants. The number of Euphorbiaceæ is very considerable. They vary from trees of the largest size to minute herbs of only a few weeks' duration, and from having both calyx and corolla highly developed to the total absence of those organs. In fact they are constant in scarcely anything except the short character assigned them above and in their sensible properties. Acridity, a virulent corrosive property, which sometimes is so concentrated as to render them most dangerous poisons, and sometimes so diffused as to be of little importance, with all imaginable intermediate qualities, exists throughout the order. Hence some are fatal, others drastic or purgative, and some simply laxative. They also occasionally secrete a farinaceous substance, which being separated from the poison is valuable for the food of man, as in the Cassava.

Among the dangerous species of this order are the Manchineel; the Excœcaria, which derives its ominous name from its juice producing blindness; and the Euphorbias, that yield euphorbium, castor-oil, and oil of Tiglium. Among other products may be named cascarilla, the bark of a Croton; turnsole, afforded by a Crozophora; caoutchouc, the produce of *Hevea Guyanensis* (*Siphonia elastica*), *Hura crepitans*, and others.

EUPHOR'BIUM, improperly called a gum or gum-resin, since it is entirely destitute of any gum in its composition, is the concrete juice of several species of Euphorbia, either exuding naturally or from incisions made in the bark. Much of the article found in British commerce is obtained from the *Euphorbia canariensis*, while that which occurs on the Continent is obtained from *Euphorbia officinarum*, *Euphorbia antiquorum*, and other African species, particularly from *Euphorbia resinifera*, called by the Arabs Dergmuse. The branches of this plant are used in tanning, and to it morocco leather owes its peculiarities. By the most recent chemical analysis euphorbium seems to consist of 38 per cent. of resin, and 22 per cent. of euphorbon, together with mucilage, malates, and mineral compounds. The resin is the active principle, and differs in some respects from most other resins.

Euphorbium is a powerful acrid substance, causing irritation and inflammation of the parts with which it comes in contact, and by sympathy affecting the nervous system. Delirium and stupor approaching to apoplexy have followed the inhalation of the dust. When swallowed it causes, in small doses, vomiting and purging; in larger doses it produces inflammation of the stomach, and sometimes proves fatal. It is now little used, even as an external application to produce vesication or ulceration, except by veterinary surgeons.

EUPHOTIDE. See GABBRO.

EUPHRA'TES, a river of Asiatic Turkey famous from the earliest period of the world's history. It is formed by the confluence (about 39° N. lat., 39° E. lon.) of two rivers, the Murad and the Kara-su. The former of these rivers rises near the mountains which encircle Lake Van; the Kara-su rises near Erzeroum; and both flow through very hilly regions. Their point of junction is about 4000 feet above the level of the sea. A few miles below this the Euphrates precipitates itself through a gap in the mountains which extend from east to west between the Murad and the Upper Tigris. In this part of its course the stream is hemmed in by lofty precipices and interrupted by rocks and small rapids. Forty-five miles below Sumeisat (the ancient *Samosata*) the Euphrates is navigable for vessels drawing 4 feet of water. After emerging from this mountainous region it flows through the great plain of Syria, taking first a south-western then a south, and finally south-eastern direction, about the thirty-sixth parallel of latitude. It maintains this course until it falls into the Persian Gulf. From Sumeisat to Hit it has a rocky bed, but thence to its junction with the Tigris its course is through almost stoneless desert. In this latter part of its course there are several great canal works for the purpose of watering the country between the Euphrates and Tigris, among which is the Saklawiah Canal. Through the break in the banks caused by the canal the whole country west of Bagdad is flooded.

The Euphrates is here only 18 miles distant from the Tigris. Near this part are the remains of three other ancient canals which formerly united the two rivers. From the mounds of Mohammed the Euphrates flows across a flat barren country to Hillah, 50 or 60 miles distant from Bagdad. From Hillah to a bifurcation a short way above Lamlum the volume of water is materially diminished by canals of irrigation. Here it is that the pestilential Lamlum marshes are situated; they are the ancient *Paludes Chaldaici*. At 57 miles from Karayim the Euphrates is joined by the Hai, the branch which diverges from the Tigris at Kut-el-amarah; and 78 miles further on it receives at Kurnah the waters of the Tigris. The distance (by water) from the remotest sources of the Tigris to Kurnah is about 1146 miles, but the Euphrates is nearly twice as long as this. The united rivers form one tidal channel, known by the name of the Shat-el-Arab, about half a mile wide. Five miles below Kurnah it is joined by the Kerkhah. From Kurnah to Basrah is 40 miles, and thence to Mohammerah, where the Karun joins the Shat-el-Arab, 28 miles. Between Kurnah and Basrah the river has an average breadth of 600 yards with a depth of 21 feet; between Basrah and Mohammerah, a breadth of 700 yards and a depth of 30 feet. The current below Kurnah is 2 miles an hour during the flood and 3 during the ebb tide, and the river is navigable for large vessels of war. Between Kurnah and Mohammerah the river forms five large islands.

The name Euphrates is said to be derived from the Greek *euphrainein*, to exhilarate or make glad, because its waters, like those of the Nile, fertilize the adjacent lands. Its banks were in ancient times the seat of many noble cities. The small mean town of Hillah occupies a minute portion of the site of the once mighty Babylon, "the glory of kingdoms, the beauty of the Chaldees' excellency;" Hit (the ancient *Is* or *Acopolis*), Anna (the ancient *Anetho*), Kerkisiah (*Cercusium*), and Bir are among the other

towns on its banks; but Bussorah or Basrah, on the Shat-el-Arab, is at present the only existing large city. It receives the waters of comparatively few rivers.

The valley of the Euphrates was surveyed by Colonel Chesney in 1835-37, with the view of its affording a very accessible and direct highway to India. The overland route and the Suez Canal have successively shelved the project, but the Euphrates Valley route has still very warm advocates.

EU'PHUISM is the name given to an affected style of talk of Elizabeth's day, first rendered popular by Sydney's "Arcadia," but exaggerated past endurance in Lyly's "Euphues, or the Anatomy of Wit," whence the term euphuism. The name of Euphues is due to Ascham's "Scholemaster," and means quickwitted. Scott, in "The Monastery," has given an excellent burlesque of euphuism in the character of Sir Piercie Shafton, a man of quaint conceits and verbal antitheses. But Scott's caricature has too often been taken for a representation. This is most unfair to Lyly, whose "Euphues," though disfigured by the mannerism alluded to, is notwithstanding an earnest and even religious appeal in favour of a wise education, and of firmness under the trials and temptations of life. Whole pages of the little book are made up of Bible texts.

EU'PIONE, a hydrocarbon, commonly present among the products of destructive distillation, particularly those from wood, coal, and bones, as in wood-tar, coal-tar, and bone-tar, especially the latter. It is a colourless liquid of low refraction and of agreeable odour. Its specific gravity is 0·650. It boils at 116° Fahr., and evaporates rapidly in the air. It is inflammable, and consists mostly of hydride of amyl (C_5H_{12}). It is insoluble in water, but mixes with alcohol, ether, and oils. It is a good solvent for sulphur, caoutchouc, and fats, but not for resins.

EUPLEXOP'TERA is a group of insects forming a suborder of ORTHOPTERA. This group is distinguished by having the hinder pair of wings folded both transversely and longitudinally. The last segment of the abdomen is provided with a large movable forceps. The upper wings or tegmina are very short, leathery, and without veins. The antennæ are slender, threadlike, and vary in the number of their joints, from twelve to forty. Ocelli are absent. This group contains only one family, Forficulidæ or EARWIGS.

EURE, a department in the north of France, formed out of a portion of Haute Normandie, is bounded N. by the department of Seine-Inférieure, E. by those of Oise and Seine-et-Oise, S. by those of Eure-et-Loir and Orne, and W. by Calvados. Its greatest length from east to west is 65 miles, from north to south 60 miles. The area is 2249 square miles, and the population in 1882 was 364,291.

The department presents a varied succession of well-cultivated fields, farms inclosed with hedgerows, large forests, hills of moderate elevation, rivers, bustling manufacturing towns, ancient castles, a few marshes in the south-west, and a small extent of coast along the embouchure of the Seine. The surface on the whole is level; the highest elevations, Mont Roti near Pont-Audemer, and the rocky promontory of Quillebœuf, are not more than 300 feet above the sea-level. The department belongs entirely to the basin of the Seine, which river crosses it from S.E. to N.N.W., and divides it into two unequal portions. On the right bank of the Seine, and between the Andelle and the Epte, lies the richly cultivated territory of the Norman Vexin and the forest of Lyons. On the left bank of the Seine there is a series of five plains, which in most instances consist of a dry soil, and have no water-courses except the rivers that bound them.

The department takes its name from the Eure, which, rising in the department of Orne, runs from north-west to south-east into the centre of the department of Eure-et-Loir, whence turning north-east it passes Chartres and Maintenon. From this last town it runs nearly due north till it reaches the boundary of the department, along which it runs for a few miles in a north-east direction, and again turning north it passes Pacy and Louviers, and enters the Seine on the left bank near Pont-de-l'Arche, after a course of 93 miles. This river was formerly navigated from Chartres to the Seine, but only that portion of it which is within this department is now navigable. The articles of transport along the Eure are salt, timber, and fuel-wood. Its principal feeders are—the Vesgre, which joins it on the right bank near Ivry; the Blaise, which joins it on the left bank below Dreux; the Avre or Aure, which flows from the department of Orne along the confines of Eure and Eure-et-Loir, and enters the Eure at the point where that river becomes navigable; and the Iton, which, rising in the east of the department of Orne, near the monastery of La Trappe, flows north-east into the department of Eure, passing Breteuil and Damville; below this last-named town it has an underground course for 9 miles, but reappears through numerous springs near Conches, and passing Evreux enters the Eure at Planches, after a course of 72 miles. The other rivers are—the Rille, which rising in Orne flows in a northern direction through this department, passes Beaumont, Brionne, and Pont-Audemer, from which to its entrance into the Seine it is navigable for large barges; the Epte, which rises in Seine-Inférieure, flows in a southern direction along the eastern boundary of the department, and joins the Seine on the right bank a little above Vernon; and the Andelle, which rises near the source of the Epte and flowing south-west enters the Seine from the right bank, nearly opposite Pont-de-l'Arche. On the two last-mentioned streams are several important iron-works; the other rivers drive the machinery of a great number of corn-mills and paper-mills and factories.

The extensive cultivation of corn in the plains gives them a rich but monotonous appearance. The roads, as in all parts of Normandy, are lined with rows of apple and pear trees. Besides corn of all kinds, more than enough for the consumption, hemp, flax, apples and pears for cider, plums, cherries, teazles, weld, leguminous plants, and garden stuffs are abundantly grown. Horses of the Norman breed are reared in considerable numbers; sheep are numerous, and esteemed for their flesh. The best fat cattle brought to the Paris markets are from the rich pastures of Roumois and Lieuvin. Hogs of large breed are reared in great numbers. Poultry is abundant, and of excellent quality. The vineyards of the department are for the most part confined to the valleys of the Eure, the Iton, and the Seine. The annual produce of cider is estimated at 30,000,000 gallons. The most common trees in the forest are oak, elm, beech, maple, and birch. The long rows of lofty poplars in the neighbourhood of the Seine are a characteristic feature in the scenery. Farms range from 30 to 300 acres. The farmhouses and farm buildings are mostly built of wood, and covered with tiles or thatch. The dwellings of the poorer classes are built of wood and clay, and thatched.

The department is rich in iron ore; building stone, millstones, and paving granite are quarried; fullers' earth and potters' clay are found. There are mineral springs at various places in the department. The manufactures consist of fine and coarse woollen cloths, linen, thread, calico, paper, printed cottons, cotton yarn, cutlery, tape, cotton hosiery, blankets, carpets, wind instruments, horn and box-wood combs, glue, nails, pins, hardware, &c. There are twenty-five furnaces and foundries for the manufacture of iron, glass-works, numerous flour and paper mills, dye-houses, fulling-mills, marble-sawing works, sugar refineries, bleaching grounds, important copper foundries, zinc works, and a great number of tanyards. The exports are composed of the various agricultural and industrial products

named; the imports, chiefly of the raw material required in the numerous manufactures, and of colonial produce. There are 698 wind and water mills, and 727 factories of different kinds in the department.

The department is crossed by twelve governmental, twenty-six departmental, and forty-seven parish roads. It has great facilities for communication by the Seine, and by the Paris and Rouen Railway, which has 84 miles of its length in this department, all, as far as Pont-de-l'Arche, on the left bank of the Seine. From this line two branch railways have been made, one from near the Vernon station through Evreux and Conches, the other from near Pont-de-l'Arche to Bernay, where it meets the former, and is continued through Lisieux to Caen.

The climate is variable and moist, but healthy and temperate; winds from the south-west and the north-west prevail; fogs are frequent; from ninety-five to a hundred days in the year are rainy.

The department is divided into the following arrondissements, viz.:—Evreux, Louviers, Les-Andelys, Berney, Pont-Audemer. The capital is Evreux.

EURE-ET-LOIR, a department in France formed out of parts of Orléanais and Maine, is bounded N. by the department of Eure, N.E. and E. by Seine-et-Oise, S. by Loiret and Loir-et-Cher, and W. by the departments of Sarthe and Orne. The districts of Orléanais included in the department are—Beauce, which covers all the east and part of the south of the department, and a portion of which, about the city of Chartres, took the name of Chartrain; and Dunois in the south-west, of which Châteaudun was the capital. The west of the department, including the arrondissement of Nogent-le-Rotrou, and a portion of that of Dreux, consists of a part of Haut Perche and Perche-Thimerais, districts of Maine, which had Nogent-le-Rotrou and Châteauneuf for their respective capitals. Its length from N. to S. is 68 miles; its breadth varies from 57 to 86 miles. Area, 2117 square miles; population, 280,097.

The department lies high up on the watershed which sends its rivers to the Bay of Biscay and the English Channel. The surface is in general level, the Beauce districts consisting of vast plains destitute of water-courses, springs, and trees; but the south and west of the department is more diversified, and presents hills, well-watered valleys, and in some places ponds and marshes. It takes its name from the two rivers that drain it—the Eure, described in the last article, and the Loir, which rises in the department, and drains its south-western districts, receiving the Thironne, the Ozanne, the Conne, and the Yère. The only other river is the Huisne, which just enters the west of this department. None of these rivers are navigable.

The soil in all the eastern and southern parts is fertile, well cultivated, and admirably adapted for growing wheat. The corn produced in these districts is of the best quality; it is for the most part sent for the supply of Paris, La Beauce having been at all times considered the granary of that capital. In the Perche districts the culture of bread-stuffs is joined to that of apples for making cider, which is more agreeable than the cider of Normandy, but not so strong. Here the farms are divided by hedges, and the country, having vineyards on the hill-sides and a tolerable clothing of trees, is called the "covered country," to distinguish it from the bare plains of Beauce. Wheat, rye, barley, oats, leguminous plants, teazles, weld, flax, hemp, &c., are grown. Hops grow spontaneously in some districts of this department. Oak and birch are the prevailing trees of the forests. Horses are bred by the farmers of Perche; horned cattle are deficient in numbers, owing to the small extent of grass land: the sheep are valued for the fineness of their wool; pigs and poultry are numerous and abundant. Of game there are hares, rabbits, red and gray partridges, plovers, lapwings, &c. The rivers contain carp, trout, pike, and crayfish.

The villages and hamlets of Beauce are built of clay and thatched, and are in general far apart. In Perche they are built of clay and stone, and covered with tiles, staves, or sometimes with heath; but in this district the hamlets are very numerous. The people of the plains are called Beaucerons; the people of Perche are called Percherons. The peasants of both districts commonly wear the blouse and the heavy sabots (wooden shoes). The costume of the women of Perche is neat and picturesque; the women of Beauce, though clothed in more costly stuffs, are not distinguished for taste in their costume.

The department is essentially agricultural, and, except in the arrondissement of Dreux, the manufactures are not very important. The number of wind and water mills for the manufacture of flour is 684, and 400 of these are driven by the waters of the Eure and the Loir. Along the course of the Avre or Aure there are important paper-mills belonging to the Messrs. Firmin Didot. There are also numerous other paper-mills, tanning and fulling-mills, cotton-spinning factories, five iron forges and furnaces (which are supplied with ore partly from the mines of the department, and partly from those of Eure), and other factories and workshops of different kinds. Besides the articles indicated flannels, serges, druggets, blankets, linens, sieves, and woollen hosiery are manufactured and exported. A great number of caps are knitted of the fine wool of Beauce or of Spain, and sent to Orléans, where they are dyed of different colours, and form an important article of export. The imports are wine, brandy, timber, wool, cloth, colonial produce, &c. Stone, marble, granite, and gypsum are quarried. Marl is very abundant, and is used for manure. Brick-clay and potters' clay are found. There are mineral springs near Chartres, and in the park of Ferté-Vidame.

The climate is healthy; the temperature is not subject to sudden changes. The heat of summer is seldom oppressive; the winters are cold and dry; fogs are not unfrequent; a good deal of snow falls in the winter; and the crops often suffer from hailstorms. The prevailing winds are the east and west. The west wind blows at times with such violence as to carry the sea-birds into the middle of the plains of Beauce.

The department is divided into four arrondissements—Chartres, Châteaudun, Dreux, and Nogent-le-Rotrou. Chartres is the chief town.

EURIP'IDES, the great Greek dramatist, is said to have been born at Salamis in B.C. 480. His father, Mnesarchus, and his mother, Clito, seem to have been Athenian citizens of the poorer class. Euripides devoted himself early to the study of philosophy in the school of Anaxagoras, as well as to that of eloquence under Prodicus. He is said to have commenced writing at the age of eighteen; and in the course of a long life he composed seventy-five tragedies, or, according to other authorities, ninety-two; and notwithstanding the satirical attacks which in the author's own time they sustained from such as were exclusively attached to the elder tragic school, they secured him for all succeeding ages a place beside its two great masters. When upwards of seventy years old he accepted the invitation of Archelaus, king of Macedon, and went to live in tranquil retirement at his court. He is said to have died in consequence of being torn by the king's hounds.

Of the numerous tragedies of Euripides nineteen survive—a much larger proportion than has descended to us of the works either of Æschylus or Sophocles. The "Electra" of Euripides, one of the least meritorious of his extant plays, affords the clearest means of comparison between his most prominently distinctive features as a dramatist and those of his two great predecessors, this being the only instance in which we have a piece from each and all of the three composed upon the same historical or

mythological subject. "Orestes" is more vigorous and more affecting than the "Electra." For moral sentiment and unaffected yet overpowering pathos his "Ion," his "Iphigenia in Aulis," and above all his "Alcestis," are peculiarly distinguished. He found subjects especially suited to the development of his finer powers in the purity and sanctity of the youth from whom the first of these three tragedies is named, in the unsuspecting innocence of the heroine of the second, and in the tender yet resolute devotedness of connubial affection portrayed in the third. The "Hippolytus" and the "Medea," exhibiting all the romantic violence of irregular and vehement feminine passions, are among the greatest and most successful works of this dramatist. Euripides aimed at actuality in his work. His diction as well as his characters are nearer real life than that of Sophocles, and still more than that of Æschylus. At the same time he does not scruple to treat the gods with a somewhat irreverent hand, as when Herakles comes forth half-tipsy in the "Alcestis," &c. A pleasant subacid flavour of philosophical free-thought pervades his tragedies. See further GREEK DRAMA.

The "Cyclops" of Euripides is the sole remaining specimen of the *satyric* drama, so called from the chorus of Satyrs which formed an essential part of its composition. It seems that the satyric drama was never acted but as a kind of shorter and lighter after-piece, for which purpose it appears to have been very constantly employed, each tragic trilogy being almost invariably accompanied by one of these shorter and lighter productions. Notwithstanding its burlesque ingredients, the tragic character was so far preserved in the satyric play, that the subject appears to have been always historical, and the action partly serious, though with a fortunate catastrophe. The piece of Euripides has for its subject the adventure of Ulysses with Polyphemus, as related in the Odyssey, with the addition of Silenus and his satyr band; the characters are accurately discriminated and consistently maintained; and the nature of the plot produces such natural contrasts and even blendings of the ludicrous with the horrible, as above all things else render this drama unique among the Grecian remains.

The editions of Euripides are numerous. The last complete editions are by Kirchhoff (Berlin, 1855), Paley (1858), and Nauck (Leipzig, 1857–69). The editions of separate plays are also numerous.

EUR'ITE. See FELSITE.

EURO'PA, a Phœnician princess, daughter of King Agenor, was so lovely that Zeus himself stooped from heaven to woo her. The Greek myth runs that he mingled with the herds of Agenor in the form of a white bull, so gentle and so finely formed that the maidens could not resist springing on his back to ride. But when the bull felt that he bore Europa, he plunged into the sea and swam from Asia to Crete. The children of Zeus and Europa were Minos, the famous lawgiver of Crete, Rhadamanthus, and Sarpedon. The first two were among the inflexibly just judges of the shades in Hades. Europa married the King of Crete, who acknowledged her sons by Zeus, and brought them up as his own. The myth of Europa and the bull is a favourite one with statuaries. As Crete was held to belong to Europe, the princess is considered to have given her name to the continent.

EUROPE is one of the five large divisions of land into which geographers divide the globe, and which they call continents. It forms the north-western part of the Old World. The surface is calculated to contain about 3,700,000 square miles.

Europe is bounded on the N. by the Arctic Ocean, and is separated from America by the Northern Atlantic, which washes its western shores, and from Africa by the Mediterranean Sea. The boundary-line which divides Europe from Asia is only in part indicated by nature. This line runs through the Archipelago, the Straits of the Dardanelles, the Sea of Marmora, and the Straits of Constantinople, to the Black Sea, which is traversed by it. It then traverses a line, rather vaguely defined, along the Caucasus, and through the Caspian Sea, the Ural River, the Ural Mountains, and the river Kara. The Russian government however, having territory both in Asia and Europe, altogether disregards the Ural Mountains as a boundary in her administrative system.

The most northerly point of Europe is North Cape, in 71° 10′; the most southern is Punta de Tarifa, in Spain (36° N. lat.); the most western is Cape La Roca (9° 28′); and the most eastern point is in the Ural Mountains, west of Ekaterinburg (60° 20′ E. lon.) But some of the islands extend further south and west than the continent. A straight line drawn from Cape St. Vincent to the mouth of the river Kara on the Frozen Ocean gives the greatest length of Europe, about 3400 miles; and another drawn from Cape Matapan to Cape Nord Kyn is 2400 miles.

Progress of Discovery.—Homer, who lived about 1000 years B.C., was acquainted with the countries round the Ægean Sea or Archipelago and on the south coast of the Black Sea. About the sixth century B.C. the Greeks began to form settlements in the southern parts of Italy and on the island of Sicily. In the time of Herodotus (450 B.C.) the countries on each side of the Mediterranean Sea and on the northern shores of the Black Sea were pretty well known to the Greeks. After the Romans began their conquests, the interior of Europe became gradually known. The conquest of Italy was followed by that of Spain and the southern parts of France; and not long afterwards Sicily, Greece, and Macedonia were added. Cæsar conquered Gallia and the countries west of the river Rhine. His two expeditions into Britain made known also in some measure the nature of our island and its inhabitants. The countries eastward of the Rhine, being for the most part plains inhabited by barbarous tribes, resisted the attacks of Rome for a longer period.

New tribes were brought within the knowledge of Western Europe by the exertions of Christian missionaries. After the fall of the Western Empire missionaries penetrated into Eastern Germany. In the ninth century others went from Constantinople into Russia; in the tenth century Christianity (and with it geographical discovery) was carried into Poland, and into Prussia in the thirteenth century. The pirates of Scandinavia, during their attacks on the coasts of Western Europe, revealed much knowledge concerning their own country.

Physical Geography. — Nearly two-thirds of the surface of Europe consists of an immense plain; the remainder is partly mountainous and partly hilly. The plain occupies the central and eastern parts of the continent; and the hilly and mountainous countries extend along its western and southern shores. This conformation divides the mountain system of Europe into two great groups, which may be termed the Scandinavian and the South European mountain systems. The plain-land occupies about 2,500,000 square miles; the Scandinavian system, 300,000 square miles; the South European system, 1,000,000 square miles.

Mountains.—The Scandinavian mountain system comprehends the whole of the Scandinavian peninsula, or Sweden and Norway, and is conjectured to have been the axis of a continent of geological times. A line drawn from the mouth of the river Torneo, at the most northern angle of the Gulf of Bothnia, to the Waranger Fiord, a bay of the Arctic Ocean, would separate it from the north-western part of the plain-land. A huge mountain-mass occupies the west part of this peninsula. It rises on the very shores of the sea to a height of some hundred feet, and attains, at a short distance from it, an elevation of 3000 or 4000 feet. South of 63° N. lat., it has not the form of a mountain-range, but of a mountain-plain, its surface

frequently presenting a perfect level, and in some places swelling into hills. The plateau is from 100 to 150 miles across, and as it attains in many parts the line of perpetual congelation, which in this latitude is about 4200 feet above the sea, a great portion of it is always covered with snow. Both shores of the plateau are deeply indented with inlets or fiords. A few summits reach 8000 feet in height. North of 68° N. lat. the mountains assume the form of a ridge, very precipitous on the western side, but sloping more gradually on the east. Minor branches spring from this ridge, and include between them many lakes. Iceland and the Faröe islands, which are included in Europe, present the same kind of elevated mountain-plain as Norway and Sweden.

Though the Scandinavian Mountains are not visibly connected with the South European mountain system, yet Great Britain may be conceived as forming such a link. The northern part of Scotland consists mainly of a plateau, studded here and there with mountains. But further south the Scandinavian character of the country is lost, and the surface presents the broken character of ridges, valleys, and plains.

The South European mountain system, which extends over the whole of South Europe, from Cape La Roca in Portugal to the Straits of Constantinople, presents a surface more diversified in its form than any other portion of the globe of equal extent, China perhaps excepted. It is a continuation of the great mountain axis of the old world which stretches through Europe and Asia for about 9000 miles from E.N.E. to W.S.W. The chief ranges in Europe bear the names of Pyrenees, Alps, Apennines, Carpathians, Balkans, and Caucasus. A plain traverses the western district from the Bay of Biscay to the Mediterranean, cutting off the Spanish from the French mountains. The Pyrenees, which bound this plain on the south, rise to a height of 6000 or 7000 feet, with isolated peaks 10,000 or 11,000 feet high. The north-east flank of these mountains rises very abruptly; but the south-west runs off into long mountainous slopes. South of the mountain-chain of the Pyrenees the peninsula is mostly occupied by a table-land, diversified with mountains.

The country between the plain of the Garonne and the valleys of the Rhone and Rhine contains an elevated region rising to between 2000 and 3000 feet above the level of the sea. On its surface rise three chains of mountains, which inclose the valleys of the Allier and of the Upper Loir. The most western part is called the mountains of Auvergne, the middle the mountains of Forez, and the eastern range the Cevennes. The country north of these mountains gradually declines to a low plain.

The country to the east of the central valley of the Rhine and Rhone comprises the great Alpine region, which at its southern extremity joins the Apennine chain of Italy. These two regions are described under Alps and Apennines. The islands of Sardinia, Corsica, and Sicily, contiguous to Italy, are all of a mountainous character.

North of the Alps, and extending from the Rhone to the Rhine, are the Jura Mountains, which consist of a number of parallel ridges. Northward of this is the long mountain range of the Black Forest, still further continued by the Odenwald. Between the Rhine and the Danube is a hilly country, which may be considered as the commencement of the elevated plain of Bavaria. This plain does not extend far enough north to reach the main plain of Europe, being divided from it by a mountain region which extends between 50½° and 52° N. lat., over the whole of Germany. To the south of the eastern part of this mountain-range is the elevated valley of Bohemia, almost entirely surrounded by mountains from 3000 to 5000 feet in height.

At the eastern extremity of this mountain system, where the rivers Oder and Moravia take their origin, the Carpathian Mountains commence. The length of this range does not fall much short of 800 miles; its breadth is not very considerable, in a few places only exceeding 70 or 80 miles. Its mean elevation may be between 3000 and 4000 feet. Spreading out from the offshoots of this chain lies the plain of Hungary, which is about 300 miles from north to south, and nearly as much from east to west. The Danube traverses it. Between the Carpathians and the lower course of the Danube is the plain of Wallachia, smaller than that of Hungary.

The Balkan, with its numerous branches, traverses the most eastern of the three great southern peninsulas, which advance from the body of the continent into the Mediterranean Sea. The Balkan range is not disjoined from the Alps by any natural separation, but is so closely connected with them as to form a continuation of that mountain system. Geographers have, however, assumed a dividing line about 18° E. lon. This very rugged region is described under Balkan. The peninsula of the Morea, which is joined to the mainland of Northern Greece by a narrow isthmus, partakes of the mountainous character of the Balkan district.

In addition to the two great mountain systems already described, Europe possesses on the eastern boundary a range of inconsiderable elevation, nowhere exceeding 6800 feet in height. These are known as the Urals. They extend along the boundary for about 1250 miles.

Volcanoes, &c.—All the active volcanoes of Europe, with the single exception of Vesuvius, are situated on islands. The principal are—Mount Etna, in Sicily; Stromboli, Vulcano, and Vulcanello, in the Lipari Islands; Mount Hecla, in Iceland. The Azores are all of volcanic origin, and contain many recently extinct volcanoes. Extinct volcanoes also abound in various parts of the interior of the continent, especially in the mountains of Auvergne and the eastern Pyrenees. The earthquake district may be said to extend from the Caspian to the Azores, the central line of concussion being more or less parallel to the Pyrenees, Alps, Carpathians, and the Caucasus.

The encroachments of the sea, the action of rivers, and volcanic and other natural causes, are constantly altering the configuration of the European coast-line. Among other important changes is one that is said to be taking place on the shores of the Mediterranean. The shores of Sicily and parts of South Italy appear to be subject to a constant elevation, and the same operation is going on on the opposite African shore in Tunis. This, if continued, would point to the redivision of the Mediterranean into two basins, as it is conjectured to have been in prehistoric times.

Minerals.—Though deficient in the precious metals, Europe is rich in the abundance of the more useful mineral products. Platinum is found only in Russia. Gold is found chiefly in the Urals and Carpathians, and extensive mines were formerly worked in Spain. Silver is worked profitably in Germany, Hungary, Bohemia, Transylvania, Sardinia, and England. Copper is exported from Spain, Sweden, and Norway, and it is raised in great abundance in Germany, Russia, Britain, Belgium, and Hungary. The most important tin mines are possessed by England. Lead is found in Scotland, England, Spain, Germany, Austria, Sardinia, and Hungary. Belgium and Germany are the chief zinc producers. Iron is very widely distributed, but is most abundant in Great Britain, the Cevennes, Vosges, Jura, Eastern Alps, and the Scandinavian Mountains. Mercury is chiefly found in Spain and Hungary. Cobalt, antimony, and bismuth are produced in Germany. Coal chiefly abounds in Great Britain, Belgium, the north of France, Germany, Austria, and the south of Russia. Sulphur is yielded by the volcanic regions. Salt is obtained all over Europe.

Lakes.—None of the European lakes are of very great extent, though many of them are situated in the midst of very beautiful scenery. The most important are those of

Switzerland and Italy. The largest is Lake Ladoga, in Finland, which is 120 miles long by 70 wide.

Islands.—The most important islands of the European littoral are the British Isles, in the Atlantic. In the same ocean are the Azores and Iceland. Zealand is an island in the Baltic belonging to Denmark. The chief islands of the Mediterranean Sea are Corsica, Sardinia, Sicily, and Candia.

Plain-land.—Plain-land entirely occupies the surface of Europe from the Ural Mountains and the Caspian on the east to Scandinavia and the Carpathian Mountains on the west, and reaches north and south from the Caucasus and the Black Sea to the Arctic Ocean. In the centre of Europe the plain extends westward between the Baltic and the mountains of Germany, until it terminates on the shores of the North Sea. Throughout the extent of this vast flat area the only elevation is presented by the Valdai Hills, in the government of Novgorod, Russia, which attain to the height of 1100 feet, and form the water-parting between the basins of the Baltic, the Black Sea, and the Caspian.

Beginning at its western extremity we find that, between the mouths of the Schelde and the Elbe, the country hardly in any place rises to more than 100 feet above the sea. Its surface is covered with a succession of moors and heaths, ill adapted for agriculture, except in the alluvial tracts along the rivers and sea-shores. The countries between the Elbe and the Vistula are more fertile. This part is drained by rivers which originate in the mountain region south of it, and traverse it in a north-western or northern direction. But east of the upper branches of the Vistula the rivers originate in the plain itself which they drain. These rivers run either north-west and north to the Baltic Sea and White Sea, or south and south-east to the Black Sea and Caspian Sea. The watershed which separates their sources begins about 23° E. lon. on the northern declivity of the Carpathian Mountains. North-east of this watershed is an immense swamp, the largest in Europe, being about equal in area to England. The watershed is continued eastward from the swamp, and in some few places reaches a height of 1000 feet. The portion of the plain north of the watershed is in general of moderate fertility; it contains a good many lakes, but scarcely any elevations except mere hills.

By far the greater part of the plain extends to the south of the watershed. Contiguous to the southern declivity extends a country of great fertility, from 300 to 400 miles in width. It begins on the west near the foot of the Carpathian Mountains, and terminates on the east at the Volga. Beyond this river the country is more mountainous. South of this fertile region extend the low plains which are called the Steppes. These present a scene of terrible monotony and stillness. There are no trees, and the only habitations are situated in hollows scooped out to a depth of from 50 to 100 feet. In the spring and early summer the land is luxuriant with beautiful flowers. In the latter part of summer it is perfectly bare and burned up. In the winter, beginning in October, it presents an unbroken surface of snow. Though the greater part of the Steppes are hopelessly barren, some portions yield immense quantities of wheat. They may be divided into the Higher and Lower Steppes, the line of separation between them being the high ground which extends north and south between the Don and Volga. The Higher Steppes occupy the western part of the plain, extending south of the fertile region to the very shores of the Black Sea. Their elevation above the sea may be between 150 and 200 feet. The Lower Steppes are at the south-eastern extremity of Europe. They occupy a space more than twice as large as the area of the British Islands. The southern part is lower than the level of the sea, the Caspian Sea being more than 300 feet beneath it, and the adjacent country rising very little above its shores.

Coast-line, Seas, and Rivers.—Looking at the map of Europe we find that its coast-line is formed alternately by wide projecting promontories and deep bays. In proportion to its surface it presents a much greater extent of coast than any other of the great divisions of the globe.

	Surface in square miles.		Coast-line. Miles.
Asia, ...	18,000,000	...	35,000
Africa, ...	14,000,000	...	16,000
Europe, ...	3,900,000	...	20,000
America, ...	15,000,000	...	32,000
	(omitting Arctic coast).		

Thus Europe is in the fortunate position of having one mile of coast-line to 190 square miles of superficial area, and it is no doubt greatly owing to the facilities for communication thus afforded, together with the number of navigable river waterways leading into the interior, that she has occupied such a high position, socially and politically, in the history of the last 2000 years.

The Atlantic Ocean forms the Bay of Biscay, the English Channel, St. George's Channel, and the North Sea. The close seas, which are united to the Atlantic by straits, are the White Sea, the Baltic, and the Mediterranean; with the latter the Black Sea and the Sea of Azov are connected. The chief characteristics of these seas are noticed under ATLANTIC, BALTIC, BLACK SEA, MEDITERRANEAN, &c. The areas of the inland seas are about as follows:—

Seas.	Extent in sq. miles.
Mediterranean, ...	760,000
Black Sea and Sea of Azov, . . .	190,000
Caspian, ...	180,000
Baltic, ...	160,000
White Sea, ...	40,000

Most of the great European rivers flow into one or other of these seas. The Caspian receives the Volga and the Ural, which drain 850,000 square miles of country. The Black Sea receives the Danube (the chief waterway of Europe), Dnieper, Dniester, Don, and Kuban, which drain 900,000 square miles (in Europe). The Baltic receives the Oder, Vistula, Niemen, Duna, and the Scandinavian rivers, which drain 900,000 square miles. The Mediterranean receives the Rhone, Ebro, Po, Tiber, &c., which drain 250,000 square miles. The rivers which flow at once into the Atlantic, without the intervention of these inland seas, though very numerous, are comparatively small, and drain only about 600,000 square miles.

Climate.—The climate of Europe presents great differences, if we compare it with that of those countries in other divisions of the globe which lie within the same parallels. It is a well-known fact that the eastern coast of North America is much colder than the western coast of Europe, under the same latitudes. The difference is in some places equal to ten degrees of latitude. The peculiarities of the European climate are chiefly explained by the position the continent occupies with reference to the water around it. The compact body of land remote from the sea is very small *relatively* to that contained in the other continents, and even to this central body oceanic influences are freely admitted. Her two great inland seas and the elevated framework or backbone of high land run east and west, or perpendicularly to the Atlantic coast; so that the prevailing westerly currents of the atmosphere, generated by the earth's rotation on its axis, find a ready access with their load of moisture to the interior of the continent. If the direction of this great chain had been meridional, and the elevation no greater than we find it, the interior would have been very differently circumstanced as regards moisture and general temperature; and such an *excessive*

climate might have reigned over large portions of it as now prevails in Central and East Russia. The causes of this are obvious: before reaching this part of Europe the westerly winds have lost all their moisture, and the north and north-east Arctic winds have unimpeded access. But had the Ural been an abrupt chain of twice the actual altitude, and been prolonged further south, the climate of East and South Russia would have been very different. Remarkably contrasted with it is the climate of Sweden and Norway, which enjoy much milder seasons in latitudes considerably to the north. Along the whole of the western coasts, indeed, the warm surface waters of the Atlantic exercise a powerful influence. They heat the circumambient air, and cause a diffusion of much milder temperatures than would otherwise prevail. It is also important to remark that Europe alone lies wholly within the region of variable winds, and thus becomes liable to many local influences not found on the other continents, which greatly modify the character of its climate.

With respect to climate Europe may be divided into three zones—the northern, the central, and the southern. In the northern zone only two seasons occur, summer and winter, the former lasting about three months and the latter nearly nine months. These seasons are separated by a spring and autumn of a few days' duration, rarely two weeks. In summer the heat is very great and the vegetation inconceivably rapid. The winter is severe and boisterous, and brings down immense quantities of snow. In the central zone the four seasons are distinct, and the passage from heat to cold and *vice versâ* is very gradual. The heat is less than in the northern zone, and so is the cold during the winter. In the southern zone frost is either not felt at all or only during a few days; and snow is of rare occurrence, or it does not lie on the ground for more than a few days. Vegetation accordingly is very little interrupted. But the countries within this zone have abundant rains during the last three months of the year, and are subject to great and long droughts in summer. These droughts frequently continue for four or five months, and in some places occasionally for eight or nine months. There is a considerable difference in the height of the snow line in various parts of Europe. Its lowest limit in the Alps is stated to be 8900 feet, while in Norway it is as low as 4000 and 5000 feet.

Inhabitants.—From the discovery of human remains in the Pleistocene formation, mixed with the bones of animals now extinct in Europe, and incapable of living under the present conditions of climate, the conclusion has been drawn that the continent was inhabited at a very early period by a race having some similarity to the modern Eskimos. They are known as Paleolithic, or Old Stone People. An interval is supposed to have taken place, during which the climate changed and the Paleolithic men disappeared, and a new race occupied the land in much the same state of civilization. To these the name Neolithic, or New Stone People, has been given. The Europeans of the present day are for the most part classed as belonging to that race which is comprehended under the name of the Caucasian; but along the Ural range, and at the most northern extremity of the continent, a few nations occur which belong to the Mongolian race; to which must be added the Magyars, who inhabit nearly the centre of Europe (Hungary).

The inhabitants of the Caucasian race may be divided into three great branches and several smaller ones, if we consider them with reference to their language. The first division comprehends those languages which are in great part derived from the Latin. They are the Italian, Spanish, Portuguese, and French languages. The second great branch is formed by those of Teutonic origin. These languages are spoken by the inhabitants of England, a great part of Scotland and Ireland, Iceland, Norway, Sweden, Denmark, Germany, and the Netherlands. The third great branch is the Slavonian, which has various dialects in Bohemia, Silesia, Poland, Russia, Dalmatia, Croatia, Bosnia, Servia, and Bulgaria. Besides these three great branches dialects of the ancient Celtic language are spoken in Scotland, Ireland, Isle of Man, Wales, and Brittany.

The inhabitants who do not belong to the Caucasian race comprise the following:—The Magyars occupy a great part of Hungary; the Lapps, the Finns, and the Samoiedes live near the Arctic Circle; while the Inghers, the Esthonians, the Livonians, the Permians, the Wogules, and the Wotyakes occupy parts of the Russian Empire; all these are of Mongol stock. To these may be added the few Calmucks, Khirghises, and Bashkirs who are on the European side of the river Ural. The Lithuanians and the Courlanders speak languages peculiar to themselves. The south-east of Europe is occupied by the Wallachs, the Turks, the Tartars, the Albanians, and the Greeks, all of whom have their peculiar characteristics of origin and language.

The population of Europe is calculated to amount to about 330,000,000. Roman Catholicism is professed by the inhabitants of Portugal, Spain, and Italy; by the large majority in France, Austria, Bavaria, Poland, Belgium, and Ireland; and by some provinces in Russia, Prussia, and Switzerland, the whole amounting to about 156,000,000. To the Greek Church belong the Russians, the Greeks, and the majority of inhabitants throughout the principality of Bulgaria; they amount altogether to about 80,000,000. The inhabitants of Sweden, Norway, and Denmark are almost exclusively Protestant; and the various sects of Protestants form the great majority in England, Scotland, Holland, Switzerland, Prussia, and the northern and western states of Germany. In France, Austria, Ireland, Belgium, and some provinces of Russia, Protestants are also numerous. The whole number in Europe is about 80,000,000. The Mohammedans, Turks and Tartars are about 6,500,000. Jews are most numerous in some parts of Russia, Poland, Austria, and Turkey. They number about 6,000,000.

Zoology of Europe.—The number of wild quadrupeds at present existing in Europe (many species having become extinct from the progress of civilization) is too small to exhibit many characteristic peculiarities; and the close connection of this continent with that of Asia makes it very difficult to draw any exact line between their productions. Many of the animals of the south of Europe are also common to the north of Africa; and most of the quadrupeds inhabiting the northern parts of our continent are found in the corresponding latitudes of Asia and America. But though the zoology of Europe does not possess much interest from the number, size, or peculiarity of its animals, this is in some measure compensated by the intimate acquaintance which we possess with the habits and manners of many of the smaller species, whose natural history has been carefully investigated by many able and industrious naturalists.

Of the horse, the lightest and fleetest breed was formerly that of Spain, which much resembled the Arabian; but it has now deteriorated. The heaviest horses are from the shores of the North Sea; the smallest are from Corsica and from the north of Sweden; Holland and Switzerland produce good draught horses; France, hardy horses; while in England the various breeds of this animal have been brought to high perfection. The ass is not attended to so much in Europe as in Asia and Egypt; the finest are in Spain and Malta. The mule, a cross between the horse and the ass, is much reared in the mountainous parts of Spain. Of the sheep, the chief European varieties are the Icelandic, the Cretan, the Wallachian, the Merino, and the several English breeds. The goat is more fitted than the sheep to bear a severe climate, and is found

in most of the mountainous districts of Europe. The largest European breeds of cattle are those of Podolia, the Ukraine, Turkey, Hungary, and Central Italy; there is a large breed in Denmark, whence have proceeded the Dutch, Holstein, and English varieties. The hog is much used for food by the peasantry of the Christian countries of Europe. In England there are many fine breeds, and some of them are fattened to a great size. Of the dog the chief European species are the Albanian, the French matin, the Irish greyhound, the great Danish dog, the common greyhound, the spaniel, the hound, the mastiff, &c. The cat is found in most European countries. The reindeer is adapted only for cold climates; it is chiefly met with in Lapland.

The whole number of wild European *Mammalia* at present met with is only 150, which includes twenty-eight belonging to the whale tribe, and eight species of Phocidæ or seals, among which the morse or walrus (*Trichecus rosmarus*) is placed; these being deducted, the number of Mammalia is reduced to 114, a proportion very small when compared with the three other great continents. Of these seventy are also found out of Europe, most of them being common to Asia; there only remain therefore forty-four quadrupeds which are now peculiar to Europe. The only quadrumanous animal is the Barbary ape, though the remains of Quadrumana are abundantly distributed throughout Europe.

Of the *Cheiroptera* twenty-seven species are found, most of which belong to the genus Vespertilio, a small and harmless race of bats. The most common and best-known species is the *Vespertilio murinus*, the flitter-mouse of the English. Most of the *Carnivora* of Europe are very insignificant animals by the side of their congeners of Asia and Africa. The only formidable beasts of prey now found within the limits of our continent are the bear, the wolf, and the lynx; but it seems probable that the lion was once met with in the south of Europe. Of the genus bear there are two species in Europe, the common brown bear (*Ursus arctos*) and the polar bear (*Ursus maritimus*). The wolf and fox, the latter under different varieties of species, appear generally distributed over Europe; the former is even now not uncommon among the wooded and mountainous districts of France. The common glutton or wolverine (*Gulo arcticus*) is a native of Denmark. Of small carnivorous quadrupeds there are several species.

Few of the *Rodentia* of Europe require particular notice. The beaver, the porcupine, the flying squirrel, the hamster, and the marmot are sparingly found in Europe; rats and mice are very abundant. Of the *Pachydermata* the wild boar is the only original European specimen. The *Ruminantia* of Europe include eight species. Of these five are deer, all of which are also inhabitants of other continents, viz. the elk or moose-deer, the reindeer, the fallow-deer, the red-deer, and the roebuck. The three remaining animals of this order are the ibex, the chamois, and the musmon. The *Cetacea* include many species of whale found near the European coasts.

The *Birds* of Europe are much more numerous than the Mammalia. Above 400 species have been described as regular inhabitants of our continent, and a good many more are occasional visitants. In the northern or Arctic regions very few birds are met with, and most of them belong to the wading and swimming orders, to whose nourishment and increase the Arctic solitudes are particularly suitable. As we proceed to warmer latitudes, and vegetation acquires a more tropical character, the number and species of birds subsisting on the produce of the earth and on insects greatly increase. On the shores of the Mediterranean there is a union of the ornithology of Europe, Africa, and Asia; the pelican, the spoonbill, and the flamingo are there met with, though not now very plentifully. Few of the birds of Europe are remarkable for that brilliancy of plumage which is so splendid a characteristic of the birds of tropical climates, but this is, in many instances, more than compensated by their sweetness of voice. The nightingale, the best songster in the world, is common in England and other European countries, though not confined to our continent.

Within the present century the Great Auk (*Alca impennis*) has become extinct in Europe.

The *Reptiles* of Europe are few, and generally harmless. The common viper is almost the only venomous serpent. There are numerous small lizards, one species of turtle, and the curious reptile named the *Proteus anguinus*.

Insects and other annulose animals are very numerous in Europe; they include, among the more troublesome varieties, the scorpion (in Sicily), the gnat, and the mosquito (in Sweden, in summer).

Many of the *Fish* which frequent the shores of Europe are very important in an economic point of view. We may particularly mention the herring, the salmon, the mackerel, and the pilchard, whose capture and preparation employ a large number of men, and which are also important articles of diet.

Botany of Europe.—This continent, in its most southern limits, exhibits a strong resemblance to the vegetation of Africa and its adjacent islands. The vine, the date, the pisang, the prickly pear, the Euphorbiaceæ, the castor-oil plant, the American aloe, rice, the sugar-cane, the cotton-plant, the *Smilax aspera*, maize, Guinea corn, the fig, the olive, the orange—all are met with in different parts of the south of Europe. At about the parallel of the south of France a marked change occurs in vegetation: most of the tropical forms of vegetation either disappear or become uncommon. Still more to the north, where the vine begins to languish, its place is better occupied by broad plains of wheat and other corn; the hardy trees of England, elms, limes, oaks, ashes, alders, beeches, birches, willows, and poplars, are found everywhere, with rich pastures and verdant fields, unknown in the land of oranges and myrtles. At last, in the more northern districts of the continent, aspens (*Populus tremula*), bird-cherries (*Prunus padus*), birches, lime-trees, alders, junipers, spruce-firs, and pines are the principal trees that remain; barley and oats are the only corn-plants, but potatoes continue to be reared in the short cold summer.

These changes take place if we merely look to the districts of the plains. In Europe, as in other parts of the world, similar alterations in vegetation occur as we ascend into the atmosphere. In Sicily, for instance, with an almost tropical vegetation in the valleys, there is a transition to the middle forms of European vegetation midway on the mountain side, and then to the most northern flora at its summit, 9000 feet above the sea, and so with other mountains as we advance to the north, till at last, on Sulitelma, in Lapland, not a trace of vegetation can be discovered above the height of 3640 feet.

History.—The earliest authentic information relating to ancient Europe is contained in the writings of the Greeks, but unfortunately very little can be gleaned from this source as to the general condition of the continent, for their knowledge was limited to a small extent of territory on the southern shores of Europe occupied by Grecian cities and colonies. Here, as early as the ninth or eighth century B.C., a very high stage of civilization had been attained as compared with the nations around. Four hundred years later the Grecian cities presented all the features of a modern community. There were substantial buildings, an orderly government, active commerce, and extensive learning. But though thus advanced the Greeks were not a conquering race, and it was not until the strong military power of the Romans came into existence that Grecian influences began to extend into the interior. When Rome, by arms, politically conquered Greece the victors

became intellectually the subjects of the conquered. Thus it came about that the Roman Empire united in itself all that Europe possessed of mental worth and military science, and that as modern military study is founded on Roman methods of war, so Grecian standards afford a measure for modern literature and art.

The city of Rome was founded in 753 B.C., and from it was developed an empire which was destined to embrace the greater part of Europe. About 1100 years afterwards, enervated by prosperity, the vast empire fell before the attacks of the barbarous and disunited Teutonic races. A time of confusion followed. It seemed as though Europe were fast relapsing into barbarism and heathenism. Asiatic tribes encroached on the undefended borders; the Bulgarians, a Mongolian tribe, the Czechs or Bohemians, the Croats and other Slavonic races obtained a permanent footing in the south-east, and the Moors took possession of the Iberian peninsula. But though superficially all seemed in disorder it was not so in reality, for the cultivation and civilization of the conquered, aided by the increasing spread of Christianity among the conquerors, were gradually softening and educating the character of the rude Goths.

At the beginning of the ninth century the Frankish leader Charlemagne succeeded in creating an empire which in extent at least recalled the dominions of the Romans; but a stronger link than the mere claim of a single family to the right of ruling was needed to unite the now mingled Latin and Teutonic races, and with the death of Charlemagne the edifice of power he had erected fell to pieces. (The attention of the reader is directed to the maps illustrative of the geography of Europe under the Empire of Charlemagne, and at the period of its breaking up.) Religion, however, had been quietly weaving an effectual bond of union, which now made itself apparent, and the bishops of Rome, as the ablest and most ambitious of the representatives of Christianity, gradually obtained the supreme control of European counsels. This supremacy was further strengthened and perpetuated by the necessity for union against the fierce attacks of the fanatical Mohammedans, who, urged on by the youthful enthusiasm of their religion, constituted a real danger to European institutions. Spain fell under their sway at the beginning of the eighth century, and it was not until seven centuries later that the fall of Granada marked their final defeat. In the name of religion, in 1096, all Europe was united under the papal leadership in the crusades against the Saracens in Asia, and many were the arts which the proud Christian warriors learned when fighting their despised but more cultivated enemy. The crusades had marked the power of the popes, but union became a matter of imperative necessity when in the fifteenth century the irruption of the Turkish hordes endangered the religion and independence of the whole continent. Constantinople, Greece, part of Hungary, the Crimea, the shores of the Black Sea, fell into their hands, but with these conquests the vigour of their first onset was exhausted.

The effects of a process that had long been going on now became apparent. The northern conquerors had gradually become commingled with their southern subjects, and a broad distinction manifested itself according as the Latin or Teutonic element prevailed. The circumstances of the struggle and local differences tended still further to split up the peoples of Europe into separate nations, with interests permanently distinct, frequently permanently antagonistic. It was now that the modern arrangement of states began to be formed.

With the development of national feeling and the spread of commerce and education the power of the popes declined, but they did not submit to the loss of their influence without a struggle. During the greater part of the sixteenth and seventeenth centuries Europe was divided into two hostile camps, in which the principles of Roman Catholicism were arrayed against those of Protestantism. As the struggle went on the religious difficulty gradually ceased to be of importance, and from its termination to the present time the chief aim of European statesmen has been to prevent any one European nation from obtaining such overwhelming power as to endanger the independence of the other nations. In modern times France alone, when under the leadership of Napoleon, succeeded in grasping an empire in some sense to be compared to that of Charlemagne, and in destroying, though only for a short time, the balance of power in Europe.

The following tables give the most interesting particulars of the various European states, according to the latest returns:—

DENSITY OF POPULATION OF THE PRINCIPAL STATES OF EUROPE.

States.	Area: English sq. miles.	Population.	Pop. per sq. mile.
Belgium, ...	11,373	5,520,009	485
Netherlands, . . .	12,648	4,172,921	329·8
Great Britain and Ireland, . .	120,832	35,026,108	290
England, . . .	50,823	24,613,926	484
Wales, ...	7,363	1,360,513	184
Scotland, . . .	29,820	3,735,573	125
Ireland, . . .	32,531	5,174,836	160
Italy, ...	114,926	28,459,451	247
Germany, ...	212,028	45,234,061	213
Prussia, . . .	137,066	27,279,111	200
Bavaria, . . .	29,292	5,284,778	180
Würtemberg, . .	7,675	1,971,118	256
Saxony, . . .	6,777	2,972,805	438
France, ...	204,177	38,218,903	187
Switzerland, . . .	15,992	2,846,102	178
Austria-Hungary, .	240,942	37,786,346	157
Austria, . . .	115,903	22,144,244	191
Hungary, . . .	125,039	15,642,102	125
Denmark, . . .	13,784	1,969,039	143
Portugal, ...	36,510	4,160,315	114
Roumania, . . .	48,307	5,376,000	111
Servia, ...	18,800	1,820,000	96
Spain, ...	191,100	16,061,859	84
Greece, ...	25,041	1,979,305	79
Turkey in Europe, .	63,850	4,490,000	70
Russia in Europe, .	2,088,419	85,058,415	40
Sweden and Norway,	293,848	6,497,245	22
Sweden, . . .	170,979	4,572,245	27
Norway, . . .	122,869	1,918,000	15

THE CREEDS OF EUROPE.

	Number.	Per cent. of Population.
Roman Catholics, . . .	155,900,000	47·27
Old Catholics, ...	140,000	0·04
Protestants, ...	79,450,000	24·10
Orthodox Greeks, . . .	80,867,000	24·36
Eastern Greek Sects, . .	1,019,000	0·31
Armenians, ...	124,000	0·04
Jews, ...	5,984,000	1·82
Mohammedans, ...	6,445,000	1·96
Others, and without creed,	447,000	0·10
Total, ...	329,876,000	100·00

THE RACES OF EUROPE.

Teutonic Stock:		
Germans (including Dutch and Flemings),	63,205,000	
English,	32,980,000	
Scandinavians,	8,945,000	
		105,130,000
Latin Stock:		
French and Walloons,	40,280,000	
Italians,	29,570,000	
Spanish and Portuguese,	20,810,000	
Roumanians,	8,240,000	
Rhæto-Romanic,	48,000	
		98,948,000
Slavic Stock: North Slavs—		
Russians and Ruthenians,	65,270,000	
Poles,	11,580,000	
Bohemians (Czechs), Moravians, Slovaks, and Wends,	7,350,000	
South Slavs:		
Croats and Serbs,	6,030,000	
Bulgarians,	2,865,000	
Slovenes,	1,260,000	
		94,355,000
Magyars (Hungarians),		6,575,000
Finns,		5,415,000
Turks and Tartars,		4,760,000
Jews,		3,474,000
Greeks,		3,125,000
Lithuanians, Letts, and Courlanders,		3,150,000
Celts,		1,942,000
Albanians,		1,816,000
Smaller groups,		1,686,000
		329,876,000

RAILWAYS AND STATE TELEGRAPHS OF EUROPE.

	Railways.		Telegraphs.	
	Miles.	per 1000 square miles.	Miles of line.	per 1000 square miles.
Germany,	23,536	111	51,869	245
Great Britain and Ireland,	19,169	159	30,276	248
France,	19,000	93	61,286	300
Russia,	16,024	·8	68,611	34
Austria-Hungary	13,957	58	35,086	146
Italy,	6,610	58	18,359	160
Spain,	5,741	30	11,158	58
Sweden,	4,307	25	5,361	31
Belgium,	2,758	242	5,711	502
Switzerland,	1,778	111	4,349	272
Netherlands,	1,482	117	2,988	232
Portugal,	948	26	3,111	85
Denmark,	1,215	88	2,447	177
Roumania	1,051	22	3,199	66
Norway,	976	7·8	4,591	37
Finland,	819	5·6		
Turkey,	587	8·4		
Bulgaria and Roumelia,	268	7	1,521	62
Greece,	327	13	4,054	
Servia,	241	13	1,736	
Total,	120,744	1195·6	330,281	3138

STANDING ARMIES OF EUROPE—PEACE STRENGTH.

Russia,	770,000	Roumania, Servia,	40,000
France,	519,000	Denmark,	35,000
Italy,	480,000	Holland,	35,000
Germany,	445,000	Greece,	30,000
Austria-Hungary,	290,000	Portugal,	28,000
Great Britain,	200,000	Norway,	19,000
Turkey,	150,000	Switzerland,	—
Spain,	125,000		
Belgium,	47,000	Total,	3,254,000
Sweden,	41,000		

EURY'ALE, a genus of plants belonging to the order NYMPHÆACEÆ. There is but one species of this genus, *Euryale ferox*, which is an elegant aquatic covered all over with prickles, with large peltate orbicular leaves, and bluish purple or violet flowers, about the size of those of the yellow water-lily. The sepals, petals, and stamens are superior; the stamens all fertile; and the carpels immersed in the cup-shaped receptacle. The leaves are from 1 to 4 feet in diameter. The fruit is a round many-seeded berry, crowned by the persistent calyx. It is a native of lakes in the East Indies and in China. The root or root-stock contains starch, which may be separated as food, or the root may be eaten, as is done by the inhabitants of the districts where it grows.

EURYD'ICE, the wife of Orpheus, died by a serpent-bite. Her husband charmed Cerberus and the rest of the guardians of the nether world by his lovely music, and so entered Hades. Here he won the hearts of the gods themselves, and was given back his wife to lead once more to the upper air. He was ordered not to look back, and did refrain till almost at the last step, when he could not resist partly turning to make sure she followed him, and she at once vanished from his sight, irrecoverably this time. "Orfeo e Euridice" is the title of one of the noblest of Gluck's operas, occasionally heard even to this day.

EURYLÆ'MIDÆ is a small family of birds confined to India, Burma, the Malay Peninsula, and the surrounding islands. This family has till recently been placed among the Rollers (Coracidæ) in the order Volitores, but its true relationship is with the American chatterers (Ampelidæ), and therefore it must be classed among the PASSERES in the division MAGNIROSTRES. From the great breadth of their bills, the species of this family have been called Broadbills.

The Javanese Broadbill (*Eurylæmus javanicus*) inhabits not only Java, but also the Malayan Peninsula, as far as Tenasserim and Borneo. It has the head and neck above chestnut-brown; the back black, with a yellow stripe down its centre, becoming expanded into a large spot on the upper tail-coverts; the wings are black, edged with yellow from the wrist downwards, and with a yellow mark on the outer web of each secondary feather, the whole forming a broad yellow band near the apex of the wing when closed. The feathers of the tail are black, with a white spot near the tip of each, except the two middle ones; the lower surface is wine-red, purplish on the throat, below which is a narrow black transverse line, followed by an olive band of a somewhat crescent shape. The bill is very broad, strong, hooked at the tip, and greenish-blue. The whole length of the bird is about 9 inches. From the shortness of its wings it is only adapted for short flights among the branches of the trees in pursuit of caterpillars and other sluggish insects.

The Lunated Broadbill (*Serilophus lunatus*) has been met with only in the Tenasserim provinces. It is about 8 inches in length; the plumage of the head and back is of different shades of brown, becoming rich chestnut towards the rump; the head is adorned with a crest, and marked with a black line running up from the base of the bill over the eye to the nape; the lower surface is of a

delicate gray, and on each side of the neck is a beautiful crescent-shaped mark, composed of silvery white feathers. The wings are black, with a large blue patch or broad band across the middle; the tail is also black, with the three outer feathers on each side tipped with white; the bill is greenish-blue. According to Mr. Davison the lunated broadbill is the most stupid of a family by no means remarkable for intelligence. These birds can be captured one by one, as they take no notice of their companions being shot, and sometimes do not move at all when the gun is fired.

EURYPTERIDA (Gr. *euros*, broad; *pteron*, wing) is an extinct group of Arthropoda, exclusively confined to the Palæozoic strata, appearing in the Upper Silurian, and becoming extinct in the Carboniferous period. They were marine animals, often of large size, some attaining a length of 6 feet. They are very closely allied to the King-crab (Limulus). The Eurypterida are usually classed with the Crustacea as a suborder of the subclass ENTOMOSTRACA. The close agreement that has been recently shown to exist between Limulus and the scorpions seems to necessitate the removal of the king-crab to the ARACHNIDA, and therefore in the same class must the Eurypterida be placed. The species are fairly numerous. Pterygotus, Eurypterus, and Slimonia are the most characteristic genera. They occur fossil in North America and Scotland. See KING-CRAB.

EURYS'THEUS. See HERACLES.

EUSE'BIUS PAM'PHILI, the father of ecclesiastical history, bishop of Cæsarea in Palestine, and the friend of Constantine, was born in Palestine towards the end of the reign of Gallienus, about A.D. 264. He became intimate with Pamphilus, bishop of Cæsarea, who suffered martyrdom under Galerius in 309, and in memory of whose friendship he added to his name that of Pamphili. In 313 he was himself raised to the see of Cæsarea, which he filled until his death. At the Council of Tyre, 335, Eusebius joined in condemning and deposing Athanasius on the charges of disobedience to the emperor in not reinstating Arius, want of respect to the council, and an alleged desecration of some sacred vessels. Eusebius was deputed by the council to defend before Constantine the judgment which they had passed against Athanasius. The part which he took in this controversy caused him to be set down as an Arian, though it appears that he fully admitted the divinity of Christ; and all that his accusers can prove is, that he believed that there was a certain subordination among the persons of the Trinity. Eusebius died 340.

The principal works of Eusebius are—1. "The Ecclesiastical History," in ten books, from the advent of our Saviour to the defeat of Licinius by Constantine, 324. 2. "De Preparatione Evangelica," in fifteen books. In this work he examines the various systems of theosophy and cosmogony of the ancient philosophers, the purest part of which, he maintains, was borrowed from the Jewish sacred writings. 3. "De Demonstratione Evangelica," in twenty books, of which only ten have come down to us. It consists of further proofs of the truth of the Christian faith, chiefly directed against the Jews, being drawn from the books of the Old Testament. 4. "The Chronicle or Universal History" was only known by fragments until it was fortunately discovered entire in an Armenian MS. version found at Constantinople, and published at Milan in 1818. The work is divided into two books; the first, entitled "Chronography," contains brief separate sketches of the history of the various nations and states of the old world, from the creation till the year 325 of our era. The other works of Eusebius are—5. "Onomasticon Urbium et Locorum Sacræ Scripturæ." 6. "The Life of Constantine," in four books, a piece of panegyrical biography. 7. A Life of his friend Pamphilus, of which only a fragment remains. 8. The "Theophania," which was discovered in 1839, and throws an important light on his religious opinions; and other minor works.

EUSTA'CHIAN TUBE, the passage which leads from the drum of the ear to the throat on each side. It supplies the tympanum with air, thus equalizing the pressure of air on each side of the drumskin, and serves as an outlet for mucus. Its aperture into the pharynx is usually shut, being only opened in the act of swallowing. If the nose and mouth be closed and the cheeks distended, a sense of pressure in both ears is felt on swallowing, due to the tympanic membrane or drumskin being bulged out by the pressure from within. An inspiratory effort under like conditions will cause pressure from the outer ear upon the membrane. In each case temporary deafness occurs for an instant, proving the necessity of the equalization of pressures to insure due hearing. [See EAR.] The passage derives its name from its discoverer, Bartolommeo Eustachius (*Eustachio*). See next article.

EUSTA'CHIUS. *Bartolommeo Eustachio* or *Eustachius*, was one of the distinguished band of Italian professors to whom we owe the restoration of anatomy and much of its advancement in modern times. He was born in the early part of the sixteenth century at San Severino, in the marquisate of Ancona. Having educated himself in the classical and Arabic languages, he studied medicine at Rome, and afterwards settled there with a view to practise as a physician, under the patronage of Cardinal Borromeo; but he never obtained any degree of professional success, and died in great indigence about 1574.

The treatises of Eustachius, short and few as they are, are of high authority and bear witness to the accuracy and extent of his researches. They are all in Latin, and are nearly all collected in his "Opuscula Anatomica" (published in 4to at Venice in 1564, by himself, and again by Boerhaave, Leyden, 1707, in 8vo). He also published an edition, with annotations, of Erotian's "Lexicon Hippocraticum."

Haller declares it to be impossible without writing a treatise on the subject to particularize the discoveries and corrections that Eustachius introduced into anatomy. In addition to the tube described in the preceding article a certain valvular membrane in the heart, which bears his name, is among his discoveries.

EUSTA'THIANS, a Christian sect of the fourth century, who refused to acknowledge any other bishop but St. Eustathius, who had been deposed by the Arians.

EUTER'PE, a genus of PALMS, natives of tropical South America. The slender stems are sometimes 100 feet high, crowned with a tuft of pinnate leaves with narrow leaflets. The berries are round, of a dark purple colour, containing a single seed.

Euterpe edulis is the assai palm of Para in Brazil. Its stem is not more than 30 or 40 feet high, while it is slender, and leaning over to one side. The fruit is like a sloe in size and colour, and is used in Para for making assai. Some ripe fruits are thrown into a vessel and warm water poured on. In about an hour most of the water is poured off, and the fruit is rubbed and kneaded, occasionally adding fresh cold water until all the pulp has been rubbed off. The liquid is strained through a wicker sieve, and is then ready for use. It is of a creamy consistence, has a plum colour, and a peculiar nut flavour. Farina, the meal made from the cassava plant, is mixed with it according to taste, and this very nutritious food forms the main subsistence of hundreds of the natives. Europeans become so fond of it that they "consider assai one of the greatest luxuries the place produces" (A. R. Wallace). There is so much variety of soil and aspect near Para that there is a continual supply all the year round. This species, as well as *Euterpe oleracea* and *Euterpe montana*, is grown in our conservatories.

EUTRO'PIUS FLAVIUS was a Latin historian of the fourth century. He was secretary to the Emperors

Constantine and Julian and accompanied the latter in his unfortunate Parthian campaign. He is the author of a compendium of Roman history, in ten books, from the foundation of the city to the accession of Valens, A.D. 364, which, being short and easy, was much used as a school-book. Meagre as it is—for it might be contained in 100 common-sized octavo pages—it is still of some use towards filling up those gaps in history which are left in consequence of the total loss of some writers and the imperfect condition in which the works of others have come down to us.

EUTROPIUS was also the name of a favourite eunuch of Arcadius, who virtually ruled the East after 395. He misused his power greatly. One of the best pieces of the poet Claudian is an invective against him. He was put to death in 400 by the Empress Eudoxia.

EUTYCH'IANS, a sect of Christians which began in the East in the fifth century. Eutyches, its reputed founder, though the opinions attributed to him are said to have existed before ("De Eutychianismo ante Eutychen," by Christ. Aug. Selig; and also Assemani, "Bibliotheca Orientalis," tom. i. p. 219), was a monk who lived near Constantinople and had a great reputation for austerity and sanctity. He was already advanced in years when in A.D. 431 he took a vigorous part in opposition to the Nestorians, who were accused of teaching "that the divine nature was not incarnate in, but only attendant on, Jesus, being superadded to his human nature after the latter was formed." In his zeal for opposing the error ascribed to the Nestorians, Eutyches ran into the opposite extreme of saying that in Christ there was "only one nature, that of the incarnate Word," his human nature having been absorbed in a manner by his divine nature. The doctrine of Eutyches was condemned by a council at Constantinople, and this decision was reversed by another council at Ephesus in 449; but at length by the council at Chalcedon, 451, which is reckoned as the fourth œcumenical council of the church, Eutyches was again condemned, and deprived of his sacerdotal office. Eutyches died in exile; but several monks, especially in Syria, continued the schism, under the general name of Monophysites, or believers in one nature. In the sixth century a fresh impulse was given to the Eutychian doctrine by one Jacob, a monk surnamed Baradæus, who himself died bishop of Edessa, A.D. 588. He was considered as the second founder of the Monophysites, who assumed from him the name of Jacobites, under which appellation they still constitute a very numerous church. The Armenians and the Copts are Jacobites, and so are likewise many Syrian Christians, in contradistinction to the Melchites, who belong to the Greek Church.

The Monothelites, who appeared in the seventh century, have been considered as an offshoot of the Eutychians or Monophysites, though they pretended to be quite unconnected with them. They admitted the two natures in Christ, explaining that after the union of the two in one person there was in him only one will and one operation. This was an attempt to conciliate the Monophysites with the orthodox church, and it succeeded for a time. The Council of Constantinople, which is the sixth œcumenical council, 680, condemned the Monothelites.

EUXAN'THIC or **PURREIC ACID**, an acid obtained from purree or Indian yellow (a substance imported from India and China), in which it exists in combination with magnesia. It is obtained in yellow crystalline needles, which are soluble in water, but dissolve more freely in alcohol and ether. The formula is $C_{21}H_{18}O_{11}$. It has a sweetish-bitter taste, and is coloured deep yellow by alkalies. It forms a number of salts, many of them coloured, called euxanthates. The euxanthate of magnesium is the salt existing in Indian yellow.

EUXINE. See BLACK SEA.

EVAG'ORAS, King of Salamis, in the island of Cyprus, from 410 to 374 B.C. His family had been deprived of the government; but Evagoras, in the year 410 B.C. returned to the island, and having killed the usurper succeeded in recovering the kingdom. He was fond of Greek culture, and zealously cultivated the friendship of the Athenians, and with the Persians, whose aid he had secured, he assisted them to gain the victory of Cnidus, 394 B.C. At a later period, however, he took advantage of the difficulties of the Persian government to extend his rule over the greater part of Cyprus; but in the end he was compelled to submit to the loss of his independence. He remained the nominal ruler of Salamis until 374 B.C., when he was murdered by a eunuch. He was succeeded by his son Nicocles.

EVANGEL'ICAL, a term which in its broadest meaning signifies anything that is in harmony with the teachings of the apostles of Christ, but which is more generally used as a party distinction in the church itself. On the Continent it is often used to distinguish the various Protestant churches from the Roman Catholic Church, and in Prussia it is the official designation of the national Protestant church formed by the union of the Calvinistic and Lutheran bodies. In Great Britain this title is generally assumed by dissenters from the national churches, and in the Church of England itself it is adopted by the Protestant or Low Church party as opposed to the Ritualists and Broad Churchmen.

EVANGELICAL ALLIANCE, a society formed for the purpose of "associating and concentrating the strength of an enlightened Protestantism against the encroachments of Popery and Puseyism, and to promote the interests of a scriptural Christianity." It was organized at Liverpool in 1845, and at present has branches in the principal towns of Great Britain and many other parts of the globe. Its members must hold what are called evangelical views, as well as the divine institution of the Christian ministry, and the authority and perpetuity of the ordinances of baptism and the Lord's Supper. The High Church party, as well as the Rationalists, have always opposed the Alliance. Great meetings of its members have been held both in England and on the Continent. A similar institution, which exists in the United States of America, under the title of the Evangelical Association, has 40,000 members, and maintains many ministers and missions.

EVAN'GELIST is the Greek appellation *euangelistes* (from *eu* and *angelos*), which signifies a messenger of any good news. In the first ages of Christianity it was a general name of all those who, either by preaching or writing, without having a particular flock assigned to them, announced the "glad tidings" of the Christian revelation. The use of the term is now confined to the four writers to whom the canonical gospels are attributed, Matthew, Mark, Luke, and John.

The evangelists are represented in pictorial art, as in church frescoes, painted windows, &c., with certain definite symbols. Matthew holds the pen and writes at the dictation of an angel. Mark writes also, and is usually seated; a winged lion crouches at his feet, sometimes thought to be a symbol of the resurrection. Luke also has pen in hand, but is not writing; he studies the scroll before him as if he were selecting from it certain passages. This is well in keeping with the selective character of the gospel; and the animal standing by the figure is equally happily chosen, for it is a cow gently chewing the cud. John, the mystic and sublime, is fitly shown as a beautiful youth rapt in thought, by whom the eagle stands with outspread wings on the point of soaring up to heaven.

EVANGELIST is the name of the third order in the Catholic Apostolic Church (sometimes called Irvingite, on account of a very distinguished preacher who joined that church); and the special functions of the evangelists belong somewhat to missionary enterprise and the propagation of church-fellowship.

EVAPORATION is the slow transformation of a liquid or solid into its gaseous state.

If liquids or certain solids be placed in an open vessel they gradually diminish in quantity by evaporation, and at length disappear; but provided no chemical change has taken place, they still exist in an invisible gaseous form. The rapidity with which this process goes on is in proportion to the temperature, the extent of the exposed surface, the pressure and movement of the surrounding atmosphere, and the composition of the evaporated subject.

The quantity of any vapour which can exist in a gaseous form in a given space depends mainly upon the temperature; but it is influenced by the state of the atmosphere with respect to the pressure of the vapour already existing or taken up. Thus there is a point at which, if the temperature remains fixed, evaporation cannot go on, and the atmosphere is said to be saturated. If, on this point being reached the temperature should fall, the vapour will return to its former state, liquid or solid, as the case may be; if to the former, it is said to be condensed, if to the latter, to be sublimated; thus water, vapour, or steam is condensed to rain or dew, and sublimated to snow or frost. If the temperature is raised, without there being sufficient solid or liquid to supply additional vapour, the atmosphere is termed superheated. Boiling occurs when the tendency of the liquid to assume a gaseous form is sufficient to overcome the united pressure of the atmosphere and its own vapour.

Dalton and Guy-Lussac found that the evaporation from ice is equal to that from water at the same temperature. Dalton also came to the conclusion that the quantity of vapour raised from a given surface of any liquid at a given temperature is directly proportional to the elastic force of the vapour at that temperature.

Solid substances and liquids of great specific gravity have vapours of small elastic force. All bodies require a much greater heat to maintain them in a gaseous than in a liquid or solid form; thus when by evaporation a liquid is transformed into a vapour heat seems to conceal itself or to become *latent* in the liquid, and a thermometer in it indicates a depression of temperature. Acting upon this property, surgical operations are often performed upon flesh rendered insensible by freezing with the very volatile spray of ether thrown upon the part—a modern elaboration of the ancient Moorish terra-cotta water-cooler, which, when exposed to the sun, chills the water it contains by the evaporation of that which oozes through its sides. So also residents in India cool their rooms by drenching with water strips of matting hung across the window openings in the fierce sun; and it is advisable to take great precautions, even sometimes to the extent of wrapping up, to avoid catching cold in the cool current of air caused by the evaporation. Few ladies are unfamiliar with the delicious solace a drop of eau-de-Cologne affords to an aching brow, or its value to check an attack of faintness. The efficacy of the remedy is increased if the evaporation is promoted by blowing upon or fanning the moistened part. In fact, so great is the chilling effect of evaporation, through the withdrawal of heat by the vapour, that liquids may be made to freeze themselves by their own evaporation readily. If water be placed under the exhausted receiver of an air-pump it evaporates freely, the water-vapour filling the vacuum; if, however the vapour is exposed to strong sulphuric acid, it is as readily absorbed by the acid, especially if by some simple contrivance the acid be kept in motion, so as to present ever a fresh surface to the vapour. In a few moments the water becomes so cold as to be a solid mass of ice. Considerable quantities may be thus produced.

Not only is evaporation so potent in its effects on heat, but it is found to be a powerful means of producing electricity, the vapour and the liquid from which it has sprung always assuming opposite states. Thus a few drops of copper sulphate thrown into a hot platinum crucible, and evaporating quickly, will produce violent electrification. It is strongly urged that the electricity of the atmosphere is due to this cause, the great oceanic evaporation constantly supplying the clouds with electric energy.

EVE (Heb. *Havva*, life) was, according to Gen. iii. 20, the name given by Adam to his wife because she was the mother of all living. In the Elohistic narrative contained in Gen. i. 27, it is declared that Elohim created man in his own image, "male and female created he them;" but in the Jehovistic narrative which follows a detailed account is given of the creation of Eve from Adam's rib. The rest of the story of the life of Eve is given in the two following chapters, the account closing with the birth of Seth. There is no further direct reference to Eve in the books of the Old Testament, but in the New the story of the creation of Eve is referred to by our Lord in reproving the lax morality of the Jews (Matt. xix. 4–6; Mark x. 5), and by St. Paul to enforce his teaching as to the position of women in marriage and the church (1 Cor. xi. 8–9; 1 Tim. ii. 12–15).

In Jewish literature numerous legends have been preserved respecting the creation and the life of Eve, some of which give unmistakable evidence of their derivation from the mythical stories of other nations.

The narrative of the creation of Eve, and indeed the whole story of the creation and fall of man, as it is given in the book of Genesis, has given rise to much speculation on the part of theologians; but though both in ancient and modern times many theories of interpretation have been propounded, no single theory has obtained anything like general acceptance. These theories may be briefly divided into the literal, mystical, and mythical, and the first of these, which accepts the story as veritable history, is that which is generally accepted as the orthodox interpretation. The method of interpretation, however, which regards the story as allegorical has found many eminent supporters both among Jews and Christians, while recent researches in the early legends of Babylon have disposed many scholars to regard the story as being the Jewish form of a myth of the creation common to the early Semitic nations.

EVECTION OF THE MOON. See MOON.

EVELYN, JOHN, the diarist, author of "Sylva," &c., was the second son of Richard Evelyn, Esq., of Wotton, in Surrey, and was born at that place, 31st October, 1620. He received his education at Lewes Free School and Balliol College, Oxford. In 1641 he went abroad; he served for a short time as a volunteer in Flanders, and with only two short intervals remained abroad till 1652. In 1647 he married the daughter of Sir Richard Browne, and on his return he lived in retirement on her property of Sayes Court till the Restoration. His character then occasioned him to be drawn from his privacy and to be frequently engaged in the public service. Among other things he was a commissioner to take care of the sick and wounded on the Dutch war breaking out in 1664; commissioner for the rebuilding of St. Paul's; a member of the Board of Trade on its first institution, &c. He was also one of the first members of the Royal Society, and continued throughout life a diligent contributor to its *Transactions*. His most favourite pursuits were horticulture and planting, upon which he wrote a variety of treatises, which are collected at the end of the fifth edition (1729) of his "Sylva, or a Discourse on Forest Trees and the Propagation of Timber in his Majesty's Dominions," first published in 1664.

Evelyn's works on the fine arts are: "Sculptura" (1662), a history of the art of engraving, in which the first account is given of Prince Rupert's supposed new method of mezzotint; "A Parallel of Ancient and Modern Architecture" (1669); "Numismata, a Discourse upon Medals" (1697). All these, though long superseded, were much esteemed, and were in fact valuable additions to the then existing stock of literature.

By the death of his brother, in October, 1699, Evelyn

succeeded to the family estate at Wotton, where he died 27th February, 1706. To the present age he is best known by his famous Diary, extending from the outbreak of the Civil War to the beginning of the eighteenth century, which contains much curious matter relative to his travels and to the manners and history, political and scientific, of the age. The work was first printed in 1818, and has gone through several editions.

EV'EREST, the loftiest mountain in the world, is situated in the Nepal ranges of the Himalayas, beyond Bengal. Its height above the sea is 29,002 feet. It is named in honour of Sir George Everest, surveyor-general of India.

EVERGREENS, in horticulture, are plants which shed their old leaves in the spring or summer after the new foliage has been formed, and are verdant through all the winter season; of this nature are the holly, the laurel, the ilex, and many others. They form a considerable part of the shrubs commonly cultivated in gardens, and are beautiful at all seasons of the year.

The principal circumstances in which evergreens physiologically differ from other plants are the hardness of their cuticle, the thickness of the parenchyma of their leaves, and the small number of breathing pores formed on the surface of those organs. These peculiarities taken together enable them to withstand heat and drought with more success than other plants, but are often not sufficient to protect them against such influences in excess. Hence we find them comparatively uncommon on those parts of the continent of Europe where the summers are hot and dry, and most flourishing in a moist insular climate like our own. This is rendered more intelligible by a comparison of the proportions borne by their evaporating pores or stomates and those of deciduous plants. As far as this subject has been investigated, it appears that their leaves are usually altogether destitute of such organs on the upper side, and that those of the lower are mostly fewer in number and much less active than in deciduous plants.

The greater number of evergreens are raised from seed; some are propagated by cuttings or layers, and the variegated sorts by budding and grafting. The soil in which they succeed best differs with the kinds. American evergreens, such as rhododendrons, kalmias, &c., grow best in equal quantities of peat-earth, sand, and vegetable mould. European sorts grow in their greatest vigour in a fresh hazelly loam, but will thrive in almost any kind of soil.

The operation of transplanting evergreens may be performed with success at almost all seasons of the year. Midsummer planting has even been recommended; it is, however, a work of necessity rather than propriety, because its success depends entirely upon the nature of the weather after the operation. If it be cloudy and wet for some time, it may succeed; but if, on the contrary, it be hot and dry, the plants will suffer; for this reason, if the practice may be adopted, it is not to be recommended. The common holly, however, has been often known to succeed when planted at this season, either for hedges or as single plants.

Autumn and spring are much better seasons for work of this kind; the plants are not so liable to suffer from the intense heat of the sun, and are more likely to be benefited by dews and rains. But, according to the most experienced cultivators, the winter months—that is, from October to February—are decidedly the best for transplanting evergreens.

It is of great importance to keep a number of the more tender sorts of evergreens in pots, in order to send them to a distance if required; and if they are to be transplanted at home their roots are not so liable to be injured as when they are dug from the ground. The more tender species of the following genera should be treated in this way:—Arbutus, Cupressus, Daphne, Erica, Juniperus, Laurus, Magnolia, Phyllirea, Pinus, Quercus, Rhamnus, Thuja, &c.

In lifting evergreens particular care should be taken of the young rootlets, as upon their preservation the success of the operation in a great measure depends; especially if the specimens have arrived at any unusual size. Small evergreens are planted like other things; but the following precautions should be observed in all cases where individuals of any great size are the subject of the operation.

When the plant has been lowered into the hole dug for its reception, the soil must be thrown in loosely around it (not trodden in), and a basin made to hold a quantity of water, which must be filled several times until the whole is completely saturated; this will convey the particles of soil down to the roots of the plant, and render it much more firm than any other method. By this treatment plantations of evergreens may be formed which, when finished, appear to have been growing for many years.

It matters little what size the plants have attained, if they can only be lifted without injuring the small fibres of the roots. Plants from 10 to 20 feet high have been moved with complete success. Should, however, the roots be injured in transplanting, the branches must be closely pruned and shortened in proportion, so that when they begin to draw upon the roots for support they may not require more nourishment than the latter can supply.

Considering the great importance of evergreens in a climate like that of Great Britain, where they flourish in such unrivalled beauty and form so much natural protection to bleak, exposed situations, they cannot be too extensively planted.

EVERLASTING FLOWERS. This name is popularly given to certain plants whose flowers have the property of retaining their brightness and colour for many months after being gathered. They owe this quality to a hardness of their tissue, which has exceedingly little moisture to part with, and which, consequently, does not collapse or decay in the process of acquiring perfect dryness. It is generally in the scales of the involucre of composite plants or in the bracts of others that this property resides. In France everlastings are called *immortelles*, and both there and in this country they are often woven into circular wreaths and placed on graves as emblems of immortality. These flowers are various species of Helichrysum, Antennaria, Gnaphalium, &c.

EVESHAM, a municipal borough and until 1885 a parliamentary borough of England, in the county of and 15 miles S.E. from Worcester, and 106 from London by the Midland Railway, is situated on both banks of the river Avon, over which there is a fine stone bridge. The four principal streets are wide and clean, and the town has a cheerful appearance. There are several churches and chapels, an old town-hall, a corn exchange, erected in 1868, the great hall of which serves as music hall and assembly rooms; the Evesham institute, market-house, public library, grammar-school, and some manufactories of gloves and hosiery and of agricultural implements. In the neighbourhood there are several medicinal springs. The vale of Evesham is famous for the richness of its soil, and large portions of land near the borough are laid out in gardens, which supply the great midland markets with vegetables and fruit. Evesham owes its importance to an abbey established there at a very early period, but of which there are now no remains except a gateway and a beautiful campanile or bell-tower, 110 feet high, that was commenced in 1533, or almost immediately before the dissolution of the institution. This is considered one of the finest existing remains of the time of Henry VIII. The municipal borough is governed by four aldermen (one of whom is mayor) and eleven councillors. Formerly the parliamentary borough returned two members to the House of Commons, but it was deprived

le by the Reform Act of 1867, and in 1885 its representation was merged in that of the county. In 1881 the population was 5112. Near Evesham a battle was fought between Prince Edward, afterwards Edward I., and the confederated barons under Simon de Montfort, on the 4th of August, 1265. The latter were totally defeated, and their leader and his son killed. The victory restored Henry III. to the throne, but he and his successors were compelled to adopt the principles of their opponent, who was the real founder of popular representation in England.

EVIDENCE. Legal evidence denotes the means by which facts are ascertained for judicial purposes. In the common law of England, where facts are ascertained by juries, the body of rules denominated the law of evidence has been gradually established within the last two centuries. The accounts of our earlier judicial proceedings, contained in the state trials, sufficiently prove that it was the practice formerly to admit, without scruple or question, every species of testimony; but at a later period distrust of the capacity of the ordinary jury, and the perverted ingenuity of the legal profession, caused a system of exclusions to be introduced, which for a long period worked immense mischief to the public. Thus it was ruled that evidence was inadmissible when tendered by the party to the suit himself, or by any person connected with him by the ties of family or the relations of business; and further, the evidence of any person whose position was such as to make it likely or possible that he would tell a falsehood was also excluded. The tendency of all recent legislation has been towards the removal of such exclusions, though one or two of an important character, to be afterwards noticed, are still retained.

Evidence, in a legal sense, may be either oral or written, and the general rules of evidence are the same in criminal as in civil proceedings. In all cases it is a rule that the *best* evidence that can be procured must be produced. Where first evidence is accessible, secondary evidence must not be substituted for it, as such a substitution raises a presumption prejudicial to the party producing it. This rule applies to written as well as oral testimony, but in regard to written testimony the following exceptions are allowed:—(1) When it is proved that the instrument has been lost or destroyed; (2) when it is in the possession of a party who is privileged to withhold it, and who refuses to produce it; (3) when it is in the hands of the opposite party, who, after notice, has refused to produce it; (4) where its production is on physical grounds impossible, or where it would be highly inconvenient; (5) where the document is of a public nature, and some other mode of proof has been specially substituted.

Written evidence consists of records, documents under seal, as charters and deeds, and writings not under seal. Any record expressed in writing or symbols may be considered a document in the legal sense. Acts of Parliament are records of the highest nature, being the memorials of the legislature; but a distinction is made with respect to evidence between public and private statutes. A public statute requires no proof in courts of justice; but private Acts must be proved by copies compared with the original roll of Parliament. A second and inferior species of records are the proceedings of courts of justice, which are proved by exemplifications, sworn copies, or office copies.

Evidence is always given upon oath, except in the case of those who object to take it; but the form of oath is immaterial. In England the oath to "speak the truth, the whole truth, and nothing but the truth," is administered on the New Testament for Christians, and on the Old Testament for Jews. Mohammedans or other persons not Christians are bound over to speak the truth by such forms as are considered appropriate to their respective creeds. Quakers and all persons who have conscientious objections to take an oath are admitted as witnesses on solemn affirmation in all courts, both civil and criminal. In all cases the punishment of perjury is attached to falsehood.

From the earliest times the law of evidence in Scotland has closely resembled that of England. Even while the ancient expedients of trial by battle, by ordeal, and the like prevailed, the rules of procedure were almost identical on both sides of the Tweed. Trial by jury in civil as well as criminal cases was afterwards evolved by very similar stages in both countries, and down to the present day the secular changes in the rejection or admission of evidence have been almost the same in character and period of adoption. The disuse of trial by jury in Scotland in civil causes, for several centuries prior to 1816, led to the introduction of numerous legal presumptions by which the natural bearing of the evidence allowed to be received was seriously warped or controlled; but with the reintroduction of trial by jury these artificial rules were gradually relaxed; and as most of the old restraints on the admissibility of evidence came to be removed in both kingdoms, it may now be said that the laws of evidence are in most respects the same both in England and Scotland. In Scotland, however, some peculiarities may still be traced, partly of continental, partly of ecclesiastical origin. Among these may be instanced "the oath of reference," *i.e.* the power possessed by either party to a suit to refer the matter in dispute to the oath of his opponent; "the oath of calumny," which must be taken by all plaintiffs in actions of divorce, to the effect that they are not acting collusively, and the like. (See Dickson "On Evidence.")

EVIL. In all ages the questions of Death, of the Freedom of the Will, and of the Existence and Origin of Evil, must, under new forms, present themselves. Man stands as it were in the centre of Nature, his fraction of Time encircled by Eternity, his handbreadth of Space encircled by Infinitude; how shall he forbear asking himself Whence, and Whither? Ever unsuccessfully: for what theorem of the Infinite can the Finite render complete? (Carlyle's "Miscellanies.")

Of these perpetual enigmas, always pressing for an impossible solution, none has exercised the mind of thinkers more than the existence and origin of evil in the world. Evil is that which contradicts, or seems to contradict, the divine ordinance. How then, if God is all-powerful and all-good, should he admit evil into the world? why did he not create a world without evil? That is the problem. Like nearly all problems in philosophy it was well attacked by the great Greeks. Plato cut the matter very short by strict logical principle. There is good in the world—now everything in nature has its contrary: heat and cold, high and low must exist together, for if all were hot heat would be imperceptible, if all were high lowness would be inconceivable, &c. Therefore, says Plato, the existence of good necessitates the existence of evil. But evil cannot exist in Plato's divine region of pure ideas, for there everything is perfect; therefore it exists in the world in which we live, where those ideas are imperfectly shadowed forth in what we call phenomena, where pure Beauty, for instance, is only imaged in partly-beautiful objects. The office of evil, therefore, according to Plato, is to spur man to escape from it, not by suicide or cowardly desertion of his post, but by study of the lofty ideals which transcend and yet underlie phenomena. Evil is in excess of good in the world, it is urged; Plato admits this at once, for phenomena are in excess of the ideas which inform them. But man is a free agent, he can choose between the evil and the transitory and the good and the permanent.

This simple and original notion of God as the author of good and evil alike runs throughout the most ancient Hebrew Scriptures. "What!" cries Job (ii. 10); "shall we receive good at the hand of God, and shall we not

receive evil?" And the conception of Satan as one of the sons of God, frequently appearing before him and subject to his supreme command, which that remarkable book embodies, is another aspect of the same notion. The view that evil was abhorrent to God, and that God and the devil were two eternal enemies, arose among the Hebrews after their captivity, when they had embraced part of the Persian teachings on such matters, teachings which about the third century of our era culminated in the doctrines of the MANICHÆANS. Not so the authors of Genesis and Exodus with their account of the primal curse, and of the immediately divine authorship of the hardening of Pharaoh's heart and of the plagues of Egypt. In the New Testament the post-exilian view of evil as the work of the devil apart from the work of God entirely prevails, and has now sunk so deeply into the popular mind as almost to preclude a philosophical view of the subject. Evil has become a personality, "the Evil One," sufficiently corporeal for legend to describe his appearance, and for Luther to assail with his ink-pot for a missile. The history of this conception is traced in the articles DEMON, DEVIL.

Spinoza was among the first of the moderns to clearly formulate what St. Augustine had long before taught more vaguely. This may be fairly described as the present view of evil among a large and increasing group of thinkers, according to which evil is not a positive but a negative quantity. It is the absence of perfection. We ourselves construct an abstraction, and then whatever does not come up to that abstraction we denominate evil; whereas on the contrary the tiger is as truly the creature of God as the camel, notwithstanding that the one seems to do us nothing but evil and the other serves our uses alive and dead. Are we then to love and protect the tiger, to pamper the thief and the murderer? By no means; they demand extermination or restraint. Yet while we deprive them of the means of harming us, we need not do so in hatred. The necessity of evil does not render punishment unjust, but it does, or it ought to, teach us to look with far different eyes upon the evil-doer than those of our forefathers. We are able now to consider ourselves greatly to blame for the wrong-doing of the thief, for instance, in that we have ourselves allowed him to grow up amid such influences as have warped his nature. We see that moral evil nearly always results from physical evil. Our punishment becomes corrective, and loses its hateful retributive character in consequence.

The great doctrine of evolution, which teaches that the whole universe, mental and spiritual as well as physical, has been evolved and is being evolved into higher forms from lower, exhibits another phase of this consolatory conception. Evil here appears as the mighty engine whence, and whence only, good arises. The claw of the tiger necessitates the bravery of the hunter, and conversely it is a platitude that dull prosperity enervates a whole nation. The pressure of the growing race, one of the most crying of evils, yet stimulates improvement in countless ways. We emigrate to less crowded countries, and the necessity of quicker communication causes the steam-vessel to be evolved, and the electric telegraph to spring into existence. A homely and not the less valuable example is yielded by the difficulty of obtaining domestic service in the United States, which has resulted in a crowd of most ingenious and valuable labour-saving machines. It is a proverb that the idle man never finds time for anything; the spur of pressure once removed which made the management of his crowded time so difficult, then even the ordinary tasks of life slip by without being done. Each difficulty and each danger calls forth, in the world of outward nature and in the world of mind alike, its correlative faculty and beauty, and without the difficulty the faculty would not exist.

But while we can thus see sufficient of the beneficent operation of evil to derive therefrom an additional trust in the beauty and goodness of the divine ordinance of things, the reason *why* the universe could not have been otherwise created, the problem of the "origin of evil" remains, and we must be contented that it shall for ever remain, inscrutable to our puny and finite minds. Tennyson has stated the whole problem in words of fire, in his immortal "In Memoriam," with a quotation from which this article may fitly conclude:—

"Oh yet we trust that, somehow, good
Will be the final goal of ill,
To pangs of nature, sins of will,
Defects of doubt, and taints of blood;

"That not a worm is cloven in vain,
That not a moth with vain desire
Is shrivelled in a fruitless fire,
Or but subserves another's gain.

"So runs my dream; but what am I?
An infant crying in the night—
An infant crying for the light—
And with no language but a cry."

EVIL EYE. From the most ancient times to our own day certain persons have been credited with the voluntary or involuntary power of the *evil eye;* namely, that whatever living thing they look upon becomes fascinated and bewitched, so that it either perishes utterly, or at any rate comes into much trouble. The Greeks and Romans repeatedly allude to this power; and there are few who do not know the often-quoted line of Virgil, where in one of his pastorals ("Ecl." iii.) the shepherd cries—

"Nescio quis teneros oculus mihi fascinat agnos"

(I cannot tell what evil eye has bewitched my tender lambs). Oriental nations are, and always have been, if possible, greater believers in the evil eye than Europeans; amulets, strips of the Koran, &c., are worn by numbers of perfectly sensible shrewd people in Persia and in Turkey. Egyptians share the superstition to the full. It is a prominent article of belief, too, with the North American Indians. Among ourselves all our older writers bear witness to the universality of the belief and the use of amulets; and even Lord Bacon has written gravely that "some have been so curious as to note the times when the stroke or percussion of an envious eye does most hurt, and particularly when the party envied is beheld in glory and triumph."

This silly superstition, as nearly baseless as a belief so general could possibly be, has not until almost within the memory of man died out among us; and that only as regards the more cultivated of our time. It arose naturally from the concentrated malignance which we perceive, so vivid that it almost seems to exist as a separate principle, in the eye of a person burning with inward jealousy and hatred. Glances such as those carry a stab with them into the stoutest heart, and it is easy to see how any misfortune arising before the smart had died away would be credited to the evil eye.

In our own time the late Pope Pio Nono (Pius IX.) was universally dreaded by the poor folk of Rome as the involuntary possessor of an evil eye, bringing misfortune on whomsoever he looked at. This did not prevent the many private virtues of that excellent pontiff from being fully acknowledged by the Italians. Also at the present day in Spain, if a guest were to look with unusual pleasure upon anything—a ring, for example—belonging to his host, the latter would at once take it from his finger and earnestly press its acceptance upon his friend; it would, however, be unheard of for the latter to accept the gift—the whole transaction is merely intended to avert the ill effects of the evil eye which an envious glance might otherwise produce. It is perhaps needless to add that among the younger and better educated this ceremony, still performed in earnest

by the bulk of the Spanish nation, rather tends to take the character of a piece of graceful politeness. Like so much else of its kind, the evil eye shrinks and retires before the searching gaze of knowledge.

EVIL, THE KING'S, an old-fashioned name for SCROFULA, derived from the fact that the touch of the king was considered to exercise a healing or modifying effect. Edward the Confessor is perhaps the earliest sovereign of England whom we know with any degree of certainty to have "touched" for king's evil, and Anne is the last. Dr. Johnson, when a lad, was "touched" by Queen Anne. George I., with a purely parliamentary title, and so thoroughly a stranger to England that he never learned to speak a word of English, neither cared enough for our old observances nor felt himself sufficiently royal "by divine right" to continue the ancient custom, and it happily dropped.

EVOLU'TION, a doctrine which, as applied to the science of life, means that all the species of living beings, both animal and vegetable, have not been originally created as we see them, but are derived from ancestors of lower and simpler organization than themselves, by a process of descent with gradual modification; that all species, however different they may now be, are descended from the same or perfectly similar ancestors, which, like the simplest living beings now known to exist, were minute gelatinous masses, without organization or structure.

The doctrine of evolution is much older than Darwin, but its prominence in recent years is due almost entirely to his work on the "Origin of Species," in which he states his belief that "animals are descended from at most only four or five progenitors, and plants from an equal or lesser number. Analogy would lead me one step further, namely, to the belief that all animals and plants have descended from some one prototype."

These views were simultaneously brought forward by Wallace and Darwin in 1858, and in the incredibly short space of ten or twelve years secured the approval of many leading minds of the scientific world. M. de Candolle had already stated that "existing vegetation must be regarded as the continuation, through many geological and geographical changes, of the anterior vegetations of the world." Sir Charles Lyell had given his conviction that "the natural operations now going on account for all known geological changes connecting the past with the present by imperceptible gradations." On the continent of Europe boldly speculative minds, such as Goethe, Oken, Lamarck, and Geoffroy St. Hilaire, had broached the doctrine that there is in living beings a like continuous series of gradations, and that the origin of the different forms of plants and animals must have been the result of gradual development or of derivation one from another. Professor Huxley has pointed out that the "modern scientific form of the doctrine can be traced historically to the influence of several converging lines of philosophical speculation and of physical observation." He states them thus:—

1. The enunciation by Descartes of the conception that the physical universe, whether living or not living, is a mechanism, and that as such it is explicable on physical principles.

2. The observation of the gradations of structure, from extreme simplicity to very great complexity, presented by living things, and of the relation of these graduated forms to one another.

3. The observation of the existence of an analogy between the series of gradations presented by the species which compose any great group of animals or plants, and the series of embryonic conditions of the highest members of that group.

4. The observation that large groups of species of widely different habits present the same fundamental plan of structure; and that parts of the same animal or plant, the functions of which are very different, likewise exhibit modifications of a common plan.

5. The observation of the existence of structures in a rudimentary and apparently useless condition in one species of a group, which are fully developed and have definite functions in other species of the same group.

6. The observation of the effects of varying conditions in modifying living organisms.

7. The observation of the facts of geographical distribution.

8. The observation of the facts of the geological succession of the forms of life.

But it was not till the appearance of the "Origin of Species," in 1859, that the theory of evolution was stated in such a form that it demanded the earnest attention of all scientific men.

The theory, in outline, is this:—All organisms are more or less variable; no two leaves in a forest are exactly alike, and the differences are often great enough to be quite conspicuous, as in the familiar case of human faces. At the same time these variations tend to become hereditary. Now, if any variation is such as to give its owner any advantage over other individuals of the same species, the owner of such a "favourable variation" will be more likely than less favoured individuals to win a place in the struggle of life, and to leave offspring. These offspring will tend to inherit the favourable variation that caused their parent to survive, and the same competition will go on among them. Those which possess the favourable variation in the highest degree will again survive, and the improvement will go on progressing and accumulating through generations. This preservation of favourable variations is what Darwin calls "natural selection."

In supporting his theory Darwin rests much on the difficulty of distinguishing between varieties and species, and on the changes which are observed to result from cultivation and domestication. He dwells on the selection which man makes in order to produce new breeds or varieties, and supposes a similar selection to take place in nature in the "struggle for life" which all plants and animals must undergo, not only against those other creatures which seem to make them their food, but still more in a competition with those which seek the same nutriment with themselves. At Nature's feast there is clearly not room for all, so many being born that only a fraction of the entire number can survive and leave offspring. There is therefore a "struggle for existence;" the race is on the whole to the swift, and the battle to the strong; there is a "survival of the fittest." In this "struggle"—which underlies the whole Darwinian theory—the stronger, or those which possess anything peculiarly favourable in their organization, must overcome the weaker, and these must therefore cease to exist. Thus a single variation, such as often takes place, may be perpetuated, and the possessors of any advantage in the means of procuring food, or in the powers of offence or defence, may entirely displace their less-favoured congeners. It is undoubtedly possible to produce, and with care to perpetuate, remarkable modifications in cultivated plants and domestic animals; and Darwin asks if it can be thought improbable that other variations useful in some way to each being in the great and complex battle of life should sometimes occur in the course of thousands of generations? And if such occur, can we doubt that individuals having any advantage, however slight, over others, would have the best chance of surviving and of procreating their kind? In this way Darwin supposes new variations to be continually taking place, but the greater number of these speedily to become extinct; while others, becoming perpetuated, and perhaps causing the extinction of the original forms, again give rise to other forms, until some of them have so widely diverged that all traces of their common origin are lost. This is Darwin's special title to the high place which he has won

in the history of human thought; that, though others before him knew that variations took place, and were due to various causes—physical, chemical, mechanical—he fully demonstrated the efficient cause of adaptation, that only the fittest survived in the battle of life.

The theory of evolution is no doubt unlike anything in our experience, but the same is true of any possible theory of the origin of species; and of all possible theories of the origin of species, that of evolution is the least out of harmony with the ordinary facts of experience. The origin of species is a matter of inference, but the origin of individual organisms is a matter of observation. Every living organism has been evolved out of a perfectly simple germ, in which the microscope shows no vestige of structure; and it would seem more consistent with this fact to believe that species also have been developed by descent with modification from perfectly simple ancestral forms, than to believe that they have been created all at once just as we see them. Embryology, or the study of the development of the germ, is of cardinal importance in any discussion of the theory. Haeckel lays it down as the fundamental law of organic evolution, that the history of the germ is an epitome of the history of the descent, or more fully, "that the series of forms through which the individual organism passes during its progress from the egg-cell to its fully developed state is a brief compressed reproduction of the long series of forms through which the animal ancestors of that organism (or the ancestral form of its species) have passed from the earliest periods of so-called organic creation down to the present time." But the correspondence between the evolution of the individual (ontogeny) and that of the race (phylogeny) is not accurate; and the reason assigned for this is that the course of development of the embryo has been from time to time altered and much shortened, so that whole series of changes that have occurred in the successive modifications of animal forms have become compressed or altogether skipped in the evolution of the germ. Heredity, a law universally admitted, has kept up in the embryo the general type of earlier animal forms; and adaptation has so modified the details that the special ancestral type at each stage of development is often difficult to recognize, especially in the very early stages.

The principal replies to the Darwinian theory of the origin of species by evolution from the lowest to the highest forms of life have come from Agassiz, St. George Mivart, Professor Cope of America, Dr. Gwyn Jeffreys, and in Germany from Dr. Albert Wigand. But even thoroughgoing evolutionists are ready to admit serious difficulties in the theory as at present formulated. The first and most natural objection is the absence of evidence of a transitional state. Animals known and described in the most ancient times are still in existence, exhibiting to this day the same characters as of old. The oldest geological evidence shows that certain classes of animals have been superseded by others; but that geological research has not yielded "the infinitely many fine gradations between past and present species required in the theory" is, Darwin confesses, "the most obvious of the many objections which may be urged against it." The difficulty is met "on the supposition that the geological record is more imperfect than most geologists believe." But Mr. Mivart points out that "the mass of palæontological evidence is indeed overwhelmingly against minute and gradual modification;" and he thinks it incredible that "birds, bats, and pterodactyles should have left the remains they have, and yet not a single relic be preserved in any one instance of any of their different forms of wing in their incipient and relatively imperfect functional condition." Granting, however, the evolution of species, it is maintained that variations have occurred which no theory of spontaneous and unguided variation is sufficient to account for; and that natural selection among small spontaneous variations is incapable of acting to the extent required.

One of the greatest difficulties of the theory is that of accounting for the origin of a co-ordinated structure, that is, of a structure in which a number of parts are adapted to each other. The most remarkable of all instances of co-ordination of parts, or, in other words, of complex adaptation, are the organs of the higher senses, the eye and the ear. Variations in such a complicated organ as the eye, in order to be improving at all, must be favourable in at least two opposite directions at once—both in respect of the nerves which contract and of those which open the pupil; and it is argued that such coincidences of accidental favourable variation are incredible in the highest degree. Indefinite and equal variability in all directions alike do not appear to be a law of nature; for the lamprey has but one nostril, while other vertebrates have two. Some animals, too, such as the chameleon and the ermine, have the singular power of changing their colour—a power of great and special value to its possessors; so much so that once a race of animals was formed with this power, there is no doubt it would be preserved and perpetuated by natural selection. But how is it first to be formed? and how many generations without this power would have to live and die before a single individual was born with the slightest tendency to change its colour with the seasons, or in correspondence with surrounding objects? It would seem impossible that such a power could have originated from the slight random spontaneous variations which alone the evolution theory admits. Again, according to Darwin, no variation can be preserved if not useful to its possessors; and granting his theory of evolution in its entirety, birds must be descended from reptiles, and their wings must be modified forelegs. Now the usefulness of a bird's wing is obvious, but *ungrown* wings are worse than useless; and how, it is asked, was the long period of transition got over during which the limb was ceasing to be either a foot or hand, without having yet become an organ of flight? Natural selection would have been more likely to destroy than preserve a race of animals in such a state. A similar difficulty occurs with the fins of fishes, for a fin in its incipient state would be as useless as an ungrown wing; and on any theory of evolution, fishes with fins are descended from finless fishes like the lamprey.

Again, it is admitted that natural selection may do in the wild state what artificial selection has done in the domestic state. It may give origin to races or breeds which possess in a higher degree some power or peculiarity of the unimproved stock; for where species are at all variable, there will be many individuals that excel the rest in strength, swiftness, and in keenness of eye, ear, or scent; and these, if kept apart, may possibly be perpetuated. But this, it is urged, accounts for comparatively slight changes, and not for the origin of anything like a new structure. It cannot be shown that the most acute and persevering ingenuity is capable of producing even the semblance of a new structure in any breed, and yet it is maintained that this is done by means of small spontaneous unguided variations. Such random variations do not act in the manner or to the extent demanded by the theory; and if they did, natural selection would be insufficient to transmit them, for even granting the unlikely supposition that the same particular favourable variation occurred in two animals at once, we have again to suppose that they will be accidentally brought together in order to perpetuate the variation, instead of its being weakened and lost by the crossing of breeds; for it is easy to prove that the variations produced by artificial selection and training are very soon lost when the animals are left to themselves. On this point Professor Huxley says "we labour under great difficulties;" the evidence is not "quite what we would like to have;" and if there is no selective breeding, "natural selection goes for nothing."

Accepting the mass of probable evidence in favour of evolution, there seems to be no data for atheistic conclusions. The fact of upward progress is not fully accounted for by natural selection alone, and it is difficult to see how the mere survival of the fittest is the one cause of the mental capacity even of the savage, or of the faculty of recognizing the good, the beautiful, and the true.

Whatever view we take of the theory, there is no doubt that it has been a most important stimulus to the systematic and careful culture of certain branches of biology, and the publication of the "Origin of Species" marks an epoch in the history of human thought. Professor Flower sums up as follows:—"Believe everything you will about man in his highest intellectual and moral development, about the nature, origin, existence, and destiny of the human soul, you have long been able to reconcile all this with the knowledge of his individual material origin according to law in no whit different in principle from that of the beasts of the field, passing through all the phases they go through, and existing long before possessing, except potentially, any of the special attributes of humanity. At what exact period and by what means the great transformation takes place no one can tell. If the most godlike of men have passed through the stages which physiologists recognize in human development without prejudice to the noblest, highest, most divine part of their nature, why should not the race of mankind, as a whole, have had a similar origin, followed by similar progress and development, equally without prejudice to its present condition and future destiny? Can it be of real consequence at the present time, either to our faith or our practice, whether the first man had such an extremely lowly beginning as the dust of the earth, in the literal sense of the words, or whether he was formed through the intervention of various progressive stages of animal life? The reign of order and law in the government of the world has been so far admitted that all these questions have really become questions of a little more or a little less order and law. Science may well be left to work out the details as it may. It has thrown some light, little enough at present, but ever increasing, and for which we should all be thankful, upon the processes or methods by which the world in which we dwell has been brought into its present condition. The wonder and mystery of creation remain as wonderful and mysterious as before. Of the origin of the whole science tells us nothing. It is still as impossible as ever to conceive that such a world, governed by laws the operations of which have led to such mighty results, and are attended by such future promise, could have originated without the intervention of some power external to itself. If the succession of small miracles, formerly supposed to regulate the operations of nature, no longer satisfies us, have we not substituted for them one of immeasurable greatness and splendour?"

("Origin of Species," "Descent of Man," by Charles Darwin; "History of Creation," "Evolution of Man," by Ernst Haeckel; "First Principles," "Principles of Biology," by Herbert Spencer; "Man's Place in Nature," by Professor Huxley; "Contributions to the Theory of Natural Selection," by A. R. Wallace; and "Genesis of Species," by St. George Mivart.)

EVOLUTION, in algebra, is the term for the extraction of roots, as the cube root, square root, &c. [See CUBE, SQUARE.] The converse term, expressing the raising of a quantity to any required power, is INVOLUTION. The usual roots required are the square root and the cube root; but the fourth root may readily be found by taking the square root of the square root, the sixth root by taking the square root of the cube root, the eighth root by taking the square root of the fourth root, the ninth root by the cube root of the cube root, &c. It is evident that by continuing the chain of reasoning shown under CUBE as underlying the method for the extraction of that root, we may directly subject any integral number to evolution to any root required, by considering it as a binomial (or expression containing two quantities) and reversing the process of involution step by step. The extraction of roots (other than those named above) is difficult and complicated as regards algebraical quantities, and is beyond the scope of the present work. The reader is referred to advanced algebraical books.

It may be noted that since in multiplication in algebra two *minus* quantities produce a *plus* product, any even root of a given quantity must have a double sign $\pm$; and any even root of a minus quantity is impossible.

EVOLUTIONS, MILITARY, are the movements made by any body of troops, either acting by itself or in conjunction with other bodies, for the purpose of arriving at or of retiring from a field of battle, or of placing itself in a position to act offensively or defensively against an enemy.

Troops in formation of route or manœuvre are so arranged as to insure the utmost flexibility of movement, combined with compactness and simplicity, otherwise large bodies of soldiers could not be handled to meet the exigencies of the country on which they operate, or to oppose the tactical combinations of an adversary in the field. The drill and training of the soldier, therefore, are to enable him to become, as it were, a living atom in the joints of the great military machine. Movements of troops are in a great measure governed by the nature of the ground they move on, by the weapons with which they are armed, by the character of the enemy they are to cope with, and by the arms he uses. To troops in the field or on the march, therefore, the power of varied and ready evolution must ever be of the greatest importance.

The column may be said to be the normal formation of troops. It is convenient as the starting point for all sorts of formation or movement, and is within more ready range of the voice and eye of the commander than other formations. A battalion may be drawn up in column, half column, or quarter column. Column is formed by the companies of a battalion being placed in rear of each other, at a distance equal to their front or breadth; thus a column is always the same depth as the front of the battalion in line less the breadth of the leading company. Half column indicates that the companies are half the breadth of their front in rear of each other, and quarter column denotes that the companies are placed six paces apart.

A battalion falls in on parade in column, the several companies having been previously inspected by their captains. The duty of "setting a battalion in the field" falls to the adjutant, who hands it over in working condition to the commanding officer. When No. 1 company is in front the battalion is right in front; and the left is the directing flank; when otherwise ordered the right becomes the flank of direction. The object of this is that when the battalion wheels or forms into line the covering by the major and the dressing by the guides is more speedily and correctly arrived at.

A battalion in column may be either wheeled or formed into line. The commanding officer gives the order, when (if a wheel) the companies wheel together, and are halted by their captains when they are within two paces from their markers, who have previously been covered by the major of the flank on which they wheel. They are dressed by their guides, who give the word "Eyes front," and on the major's word "Steady" the movement is completed. In forming the men move into their places by the file on the flank of formation turning to that flank, the remainder making a half turn and filing into their places by succession, dressing themselves as they come up. Columns on the march are wheeled and formed in the same way, only markers are not thrown out unless a halt is ordered. If the march is

to be continued, when the movement is completed, the word "Forward" is given.

A battalion in column is invariably deployed by the flank march of fours on the leading company, which remains fast; the remaining companies form fours in the direction ordered, move by the shortest lines to their places in line, and are halted by their captains and dressed by the guides, the movement being superintended by the major of the flank on which it is made. If it is intended to place the line more to the right—say three companies' distance—the order is to "deploy outwards, three companies to the right;" the leading company stands fast, the three immediately behind it go fours right, the remainder fours left, when they march to their places in line, and are dressed in the usual way; the covering is made from the flank which was directing in column.

A battalion marching in line advances by its centre. The centre sergeant selects a point to march on under superintendence of the adjutant, who gives the word "Steady" when the line of march is determined on. At the order to march the whole step off, the men touching lightly towards the centre. The sergeant-major stands fast in rear till the line has advanced ten or fifteen paces, when he advances, under direction of the adjutant, until he finds the line of march is being maintained. When the halt is ordered every man remains steady. Retiring in line is performed in the same way, only the men are turned about before they march off; when ordered to halt they are at once turned to the front.

A battalion in line may be wheeled or formed into column. When at the halt a battalion breaks into column, at the command the whole go to the right-about and wheel upon the named flank, and are halted and turned to the front by their captains, the men in column taking up their dressing without further word of command. A battalion in line may also on the march wheel or form into column, and continue its advance on the word "Forward" from the commanding officer. Formations of column from line may be made at the halt on any company; if on a flank company, the remainder go into fours—right or left—and are marched by the rear on their markers; if on a central company, the remainder go fours inwards, the men moving into column left arm to left arm. A battalion in line may advance in column from either flank or from the centre. When from a flank, the leading company advances, the remaining companies moving in fours along the rear; as each company's leading file comes in rear of the centre of the preceding company the men make a half turn to the front, and as they come into column are ordered to turn to the front, when the march is continued by the command "Forward," or the column is halted and dressed. A battalion in line may advance in columns of half battalion in the same manner on the leading companies of half battalions, or it may advance from the two centre companies, the remaining companies on either flank forming fours inwards, and moving into their places in the double column.

Battalions in line change front quarter, half, three-quarters, or at right angles. Quarter means a quarter of a right angle; half, a half of a right angle; and three-quarters, three-quarters of a right angle; right or left denoting the full quarter circle. Thus to "change front right on the right company," the right company is wheeled to the right and dressed, when the remainder wheel forward together, and when in oblique echelon, at the word "Forward" get into their positions in line in the usual way. The command "Change front left on the right company" reverses the preceding movement, and throws back the left. Thus the right company, on the command being given, at once wheels to the left, the remaining companies are turned about, wheeled on their left, and when in echelon move forward towards the alignment, on which they wheel, passing well to the rear, and are halted, turned to the front, and dressed up, and the formation completed as usual. The lesser parts of the circle are worked in the same way as the examples we have given. Front may be changed by the same method on an inner as well as a flank company.

Troops in line or in column, when interrupted in their advance by obstacles, can diminish their front by breaking off files—*i.e.* the files that are obstructed in their path turn inwards and wheel up in rear of each other on the flank of the line or column, till the obstruction is cleared, when they make a half turn and double up into their former places in the front.

Dressing the line is necessary to correct errors of formation after a long march or a charge. This is done at the halt. The markers run out, and under superintendence of the major are properly covered at several paces in front of the line. At the order "Quick march" the men step up to their markers, and are dressed according to rule.

Echelon is the most flexible of all the movements. The echelon may be direct, oblique, or short echelon. Direct echelon is the advance of the line by companies at wheeling distance from either flank. This movement permits front to be changed at once and line formed in any direction. Oblique echelon means the companies wheeled up at an angle to their former alignment. It is used for advancing to a flank, and is capable of rapid formation into line or column. Short echelon is a movement for attack in which the line is advanced, the two centre companies leading, the companies on the flanks following at half distance. Line is re-formed by the centre companies halting and the flank companies marching into their position in line; if on the march the flank companies double into their places.

The formation for Attack.—A battalion drawn up for attack consists of—1. The fighting line, whose duties are to keep up a steady fire on the enemy until a final rush is made to carry the position. 2. The support, whose duties are (1) to supply the losses in the fighting line so that its fire may never slacken; (2) to protect the flanks of the fighting line, by being at all times ready to pour in a heavy concentrated fire on any troops that may threaten; (3) to give confidence to the fighting line, supporting and connecting it with the main body. 3. The main body, whose duty in conjunction with the companies in front is to finally force the enemy's position. When the battalion, standing at ease in column, is ordered to extend for attack, the whole will come to "attention" and the object and direction of the movement will be explained. No. 1 will form the right and No. 8 the left extended companies, No. 2 the right support and No. 4 the left support. Officers return swords and the guides fall to the rear. Five or six marksmen from the two leading companies, under an officer, may be sent out as scouts, if ordered to lead the advance, and remain 100 or 150 yards in front. Nos. 1 and 8 advance, the former extending four paces from its left and the latter four paces from its right. The captains will place themselves six paces in rear of the centre, the guides three paces in rear of the outer sections, and the markers in rear of the inner sections. When extended the companies halt and lie down, leaving an interval of six paces between them. The two supports go out by the diagonal march, and place themselves in the rear centre of the extended companies at from 150 to 200 yards' distance, when they will lie down. Care will be taken on all occasions that the men fire only when ordered to do so, adjusting their sights and aiming at precise objects. These advanced companies are under a major's command. On the advance being signalled by the commanding officer the major will give the order, to be repeated by the officers of the fighting line, which will then advance, the men preserving their distance in file. The double may be ordered, but there must be no noise, hurry, or confusion permitted, and no firing will take place except at the halt. When ordered to fire the rear-rank men will run up on the left of the front-

rank men, and form rank entire (single rank). On the "Cease fire" when halted, the men, lying down or under cover, will remain steady, otherwise they will re-form files. At the commander's order the whole line advances. If scouts are sent out they may be expected at about 400 yards from the enemy's advanced troops. They will await and advance with the fighting line, any information they may have gained of the enemy being given the commanding officer by signal or otherwise. The supports will open out gradually and follow the fighting line. The main body will deploy and follow; when deployed the intervals between companies may vary from three to twenty paces. Between main body and supports the distance, as a rule, will be from 200 to 800 yards. Mounted officers will dismount whenever they come under the enemy's fire, keeping their horses in such position as to be available when wanted.

When ordered to reinforce, the supports will extend on the march (or at the halt if ordered), double into the fighting line, and form rank entire, placing themselves in the intervals and taking up the fire, files keeping together as far as practicable. The advance will then be continued by the combined companies at such a pace as the fire of the enemy may necessitate. On approaching the enemy the main body should advance to within 200 yards of the fighting line, or nearer, and replace the supports.

The advance by rushes will be made by the right combined companies advancing at a steady double for say 30 yards, when they will kneel or lie down and be ordered to open fire. They will be covered by the continued fire of the left combined companies, who will, as the right opens fire, cease fire, move forward, halt in line with them, and commence firing. The movement may be repeated and a sharp fire maintained. When the fighting line cannot push on within 100 or 150 yards of the enemy the main body will be ordered to reinforce, and will advance and form rank entire as they close on the fighting line (which, thus reinforced, will stand two deep), and dropping on the knee fix bayonets and open fire; the front rank will then also fix bayonets. The hottest fire should now be kept up. The battalion reserve may be brought up in rear of the fighting line and lie down. The order to "prepare to charge" should be quietly passed along the line, the front rank coming to the trail, while the rear rank remains at the slope; and on reaching charging distance the signal for the final rush will be made by the drums beating and the bugles sounding the charge, on which the men will quicken their pace and cheer. At the sound of the "halt" the men halt and stand steady.

Formations to resist cavalry vary according to the nature of the ground. Under the fire of modern breechloaders cavalry may be received in line, and the flank companies can, for protection, be wheeled forward or thrown back. Squares may be formed from line or column, and may be either two deep or four deep. The instant the men come into square they fix bayonets, and at the order "Prepare for cavalry" the front rank or ranks at once drop on the knee, placing the butts of their rifles firmly on the ground inside their right knees, locks uppermost, muzzles slanting so that the bayonet point is about the height of a horse's nose, while the left hand grasps the rifle firmly above the lower band, and the right holds the small of the butt, the left arm resting on the thigh. The rear rank or ranks come to the "ready," muzzles inclined upwards. At the word "Re-form column" the men are brought to the "order" and bayonets unfixed.

The evolutions of a brigade or an army are conducted on the same principles as those laid down for the movements of a battalion. The battalion holds the position in a brigade which the company does in a battalion. Battalions in line are drawn up at thirty paces' interval, which distance when required may be reduced to twelve paces. A line of quarter columns is formed at thirty paces' interval, but this may be increased to deploying interval plus thirty paces. Divisions or brigades in column of route or manœuvre must have battalion intervals equal to the breadth of their leading companies, and thirty paces, so that should the battalion wheel the thirty-pace intervals will be preserved. When in mass of quarter columns—that is, battalions in rear of each other—the distance between battalions will be twelve paces, but it may be varied so as to preserve thirty-pace intervals when the mass is wheeled into line of columns. Cautions and commands of the general are repeated by battalion commanders, but he also makes use of his staff officers to convey orders to distant battalions.

Echelon formations and movements are conducted on a line composed of large bodies of troops upon the principles laid down for the battalion. They are calculated to place a body of troops in an advantageous position to gain an enemy's flank; and sometimes they are formed with effect from the centre of a line by re-fusing each wing. If an attack made by an advanced corps of a great echelon be effectual, each succeeding one moves up to improve the advantage; if it fails, the succeeding bodies are in a position to protect the retreat, and in gradually retiring upon each other they afford mutual aid and support. It may be assumed as a principle that great echelon movements preparatory to action, and when not exposed to fire, will be made in quarter columns; and that echelon movements when under fire will be made either in oblique echelon of companies, or in echelon of battalions or larger bodies, in line. The attacks of armies are generally conducted on the principles of the echelon. There are few situations where the whole could act at the same time, or where it would be prudent that they should do so.

The advance of infantry should always be preceded by a concentrated fire of artillery on the points selected for the attack, which fire should be maintained until the last moment possible. When cavalry or artillery are required for action they should come to the front by the flanks, or when necessary they may pass through the intervals of the infantry line, care being taken that the advance of artillery is always preceded by scouts to test the practicability of the ground.

Advanced guards are formed for the purpose of covering the movements of troops, feeling the way through a country, gaining intelligence of the enemy, and giving notice of his vicinity. An advanced guard on a road may be formed of a company divided into two parts. One half company, as support under the captain, marches about 300 yards in front of the main body; the other half company, under the lieutenant, marches 200 yards in advance of it, and will detach two files 100 yards to its front, and two files 100 yards to its right and left front. The support sends out connecting files 100 yards to its front and rear. Advanced guards as they come on to a plain are extended as a line of skirmishers with support and reserve. A rear guard is an advanced guard reversed, and is formed to cover a retreat, prevent straggling, and such other duties.

EV'ORA (the ancient *Ebora*), a city of Portugal, the capital of the province of Alemtejo, 84 miles E.S.E. of Lisbon, stands on a fertile plain surrounded by ranges of hills—Sierra D'Ossa, Alpedriera, Vianno, and others. Its fortifications are now in ruins, but it has an elegant cathedral, founded 1186, and several other churches with interesting works of art, barracks, museum, and valuable archiepiscopal library, and a fine aqueduct, said to be of Roman construction, with a castellum or tower, the reservoir for the water of the aqueduct; also the remains of a temple of Diana, which is ascribed to the Roman general Q. Sertorius, B.C. 75. The temple, castellum, and aqueduct are regarded as the finest Roman remains out of Italy, but the two latter have been partly removed to make room for a market. An antiquity is claimed for the city reaching back to B.C. 560. Julius Cæsar added to its name the designation Liberalitas Julia. The city was

recovered from the Moors in 1166; it long enjoyed a high literary reputation, and many works issued from its printing presses; but it is now in a decaying state, and its only industry is in iron wares and leather manufactures. The population is 12,000.

EVREUX, an ancient episcopal city in France, the capital of the department of Eure, stands in a pretty valley shut in by hills on the north and south, and watered by the Iton, which flows through the town in three branches on its way to the Eure. It is situated 60 miles W. from Paris, and has 12,560 inhabitants. This town, or Vieil Evreux, a village near it, occupies the site of the ancient *Mediolanum*, which afterwards took the name of *Eburovices*, from the people whose capital it was, and from this the modern name is derived. The streets of Evreux are broad and neat; the houses are mostly built of wood and plaster. The cathedral, part of which dates from the eleventh century, is a very imposing structure, though it is not uniform in style. The north transept and the portal leading to it are in the florid Gothic, and are greatly admired; the west front is in the Italian style; the interior is lighted through many beautifully painted glass windows. The Abbey Church of St. Taurin, built by Richard II., duke of Normandy, also presents specimens of different styles, introduced in the various repairs it has undergone; it contains the shrine of St. Taurin, executed in the thirteenth century. Other remarkable objects are—the clock-tower, the public library, the botanical garden, the prefect's residence, the bishop's palace, the prison, the park, and the promenades in the neighbourhood, which are prettily laid out in gardens, vineyards, and meadows. The town has tribunals of first instance and of commerce, two ecclesiastical schools, a college, primary normal school, savings bank, &c. The manufactures are ticking, hosiery, woollen stuffs, vinegar, cotton yarn, leather, &c.; and the commerce of the town is composed of these articles, and of corn, brandy, cider, perry, linseed-oil, linen, hides, and groceries. Evreux was burnt by Henry I. of England in 1119, with the permission of the bishop, on the condition that he would rebuild the churches. It was again burnt by Philippe Augustus in 1198.

E'WALD, HEINRICH GEORG AUGUST VON, one of the most learned of the Orientalists of the nineteenth century, was born 16th November, 1803, at Göttingen. He was educated at the university of his native city, and soon exhibited a marked predilection for the study of the Hebrew and other Semitic languages, which he pursued under the celebrated Eichhorn. After receiving one or two minor appointments he was in 1831 made ordinary professor of philosophy at Göttingen, and in 1835 professor of the Oriental languages. In 1837 he joined with six of his colleagues in a protest against the abolition of the liberal constitution of Hanover by the new king, Ernest Augustus, a step which led to his speedy dismissal from the university. In the following year he was called to Tübingen, where he remained ten years, first as professor in philosophy and afterwards in theology. In 1841 he was ennobled by the King of Würtemberg. In 1848, the liberal constitution of Hanover having been restored, he was invited back to Göttingen, where he remained professor until after the Prussian victories of 1866, when, as he persisted in assailing the conquerors by means of public manifestoes of a violent character, and steadfastly refused to take the oath of allegiance to the King of Prussia, he was deprived of his chair, but allowed to retain his full salary. He was afterwards returned by the city of Hanover as a member of the North German and German Parliaments. He died 4th May, 1875.

As a philologist, biblical critic, historian, and theologian, Ewald stands in the first rank of modern scholars, and his contributions to each of these departments of science are such as can never be forgotten. His first work, on the "Composition of the Book of Genesis" was published in 1823, and from that time up to the closing years of his life he pursued his studies with unremitting attention, and scarcely a year passed without the publication of some important result of his labours. It would be impossible within the limits of this notice to give a list of his works, but they include contributions of the highest value in respect to the Hebrew, Arabic, Persian, Aramaic, Ethiopic, and Sanskrit languages and literature; a vast work on the history and antiquities of Israel, with a continuation down to the times of the apostles; numerous contributions to the criticism and exegesis of the books of both the Old and New Testaments; and a series of valuable dissertations on Apocalyptic literature. Many of his works have been translated into English. See "Hebrew Grammar" (London, 1836); "Introductory Hebrew Grammar" (London, 1870); "History of Israel" (five vols., London, 1867–74); and "Commentary on the Prophets of the Old Testament" (London, 1876–77).

EW'ELL or **AT-WELLS** (so named from its position at the head of a small stream which flows into the Thames) is a village, formerly a market-town, of England, in the county of Surrey, about 12 miles from London by the South Coast Railway and 14 miles by road. It is tolerably well built, and enjoys a healthy air. Richard Corbett, bishop of Norwich, was born here, 1582. There are powder and corn mills, and brick and tile works in the neighbourhood. The church, a Decorated building, was erected in 1848. The ivy-shrouded tower of the old church is carefully preserved. At Nonsuch, on the Cheam road, stood the ancient palace of Henry VIII., frequently visited by Queen Elizabeth, and pulled down by Charles II.'s mistress, the Duchess of Cleveland. The population of the parish in 1881 was 3389.

EX or **EXE**. See DEVONSHIRE.

EXAMINATIONS, PUBLIC SERVICE. Until within a comparatively recent period all the junior appointments in the civil service were made upon a system of almost unchecked nomination. The theory that prevailed was apparently that no minister would appoint an unsuitable person to an office; but practically the appointments were regarded either as a means of repaying political service, as all such appointments are now in the United States, or as a means of providing for the wants of needy members of the aristocracy fortunate enough to possess influence with a minister.

By this method, however, many incompetent persons were thrust into public offices, to the detriment of the public service, while the favouritism shown to the members of a particular class gave rise to considerable dissatisfaction. In 1853 a commission was appointed by Parliament to consider the whole question of appointments to the public service, and two years later the recommendations of this commission were adopted by Parliament, and by an Order in Council issued in 1855 Civil Service Commissioners were appointed whose duty it was to examine into and certify as to the qualifications of persons nominated to the junior situations in the civil service. These commissioners communicated with every branch of the public service, and ascertained from the different departments the subjects in which proficiency was required, and arranged a series of examinations accordingly, at which all candidates were required to attend. The order of 1855 went no further, however, than to direct the commissioners to examine such candidates as had been nominated by the heads of departments. The principle of nomination had reference to only one individual, or to more than one. In the latter case the competition was limited to a certain number nominated (usually in the proportion of three to each vacancy), and the best qualified being appointed a limited system of competition was thus introduced. In the selection of members for the Indian civil service the principle of open competition was

adopted, as it was also in the first appointments to the Indian and the imperial medical services.

The system of open competition for all junior appointments was strongly advocated from this period, and in 1857 a committee of the House of Commons reported in favour of the change, the report of the committee being adopted by a resolution of the House. It was not, however, until 1870 that by an important Order in Council the system was virtually extended to the entire civil service of the United Kingdom, only a few appointments being reserved for nomination.

Some changes were introduced into this system in 1876 by an Order in Council, based upon the recommendations of an inquiry commission presided over by Dr. Lyon Playfair, and practically the whole civil service is now divided into upper and lower divisions—the former requiring very superior attainments, and the latter, and by far the more numerous class, being for situations which require only duties of a simple and mechanical character.

After the abolition of purchase in the army in 1871, the system of open competition for appointment of officers was introduced, and only the necessary ability and good health and character are now therefore required to obtain admission into either the civil or military service of the United Kingdom.

The following is an abstract of the chief civil service, military, and naval examinations, showing age, subjects of examination, &c., in 1887:—

Open Competitions for the Home Civil Service —Male.—*Clerkships, Class I.* 18–24.—Examination: handwriting; orthography; arithmetic; English composition and précis; history of England; English language and literature; language, literature, and history of Greece, Rome, France, Germany, Italy; mathematics (pure and mixed); natural science (five branches); moral sciences; jurisprudence; political economy. Salaries very various: in a few cases, £250 to £600; mostly £100 to £400, &c.

Men Clerkships of the Lower Division, and Second Class Clerkships in India Office, 17–20.—Examination: handwriting; orthography; arithmetic; copying MS.; composition; geography; indexing; digesting returns into summaries; English history; book-keeping. Salaries: men clerkships, £95 to £250, or £80 to £200; second class clerkships in India office, £80 to £250.

Boy Clerkships of the Lower Division, 15–17.—Examination: handwriting; orthography; arithmetic; copying MS.; composition; geography. Salaries: 14*s.* per week, increasing 1*s.* per week per year. Boy clerks are not retained after the age of 19. But if between 17 and 20 they are eligible for the open competitions for men clerkships without passing a preliminary examination, and after a time compete among themselves for a certain number of these appointments.

Excise Appointments, 19–22.—(Candidates must be unmarried, but assistants can marry after six months' service.)—Examination: handwriting; orthography; arithmetic, including mensuration; composition; geography. Salaries: about £90, rising through grades to £200, with chance of rising to £320, &c.

Assistant Surveyorships of Taxes.—This examination is limited to the successful candidates of the excise competition immediately preceding. Examination: Latin, or French, or German; Euclid; algebra; book-keeping; political economy. Salaries, £100 to £400, &c.

Customs — Out-door Officers, 19–25. — Candidates must be 5 feet 4 inches in height, and 34 inches around the chest; or if 5 feet 10 inches in height, then 35 inches around the chest. Examination: handwriting; orthography; arithmetic; composition. Salaries, £55, rising through grades to £100. Out-door officers are eligible for examining officerships, £110 to £300, &c., selection being made (1) by examination, and (2) according to official merit, without examination.

India Office and India Audit Office—Superior Clerkships, 18–22.—Examination: handwriting and orthography; arithmetic; English composition; book-keeping; weights, measures, and currencies of the chief commercial nations of the world; geography; Latin; Euclid; algebra; French or German. Salaries, £100 to £300 or £350, &c.

Telegraph Learnerships—Male, 14–18.—Examination: dictation; handwriting; elementary arithmetic. Salaries, after instruction (three months), 12*s.* per week, rising through grades to £140 and £190.

Female Clerkships in the Post Office, 18–20.—Examination: handwriting; spelling; arithmetic; composition; geography; English history. Salaries, £65, rising through grades to £170.

Female Sorterships in the Post Office, 15–18.—Candidates must be 4 feet 10 inches in height. Examination: reading and copying MS.; handwriting; spelling; arithmetic (first four rules); geography of United Kingdom. Salaries, 12*s.* per week increasing to 20*s.*, with chance of further promotion.

Female Telegraph Learnerships in the Post Office, 14–18.—Examination: dictation; handwriting; arithmetic (first four rules). Salaries, after instruction (three months), 10*s.* per week, rising through grades to 34*s.*

Open Competitions for the Civil Service Abroad.—*India Civil Service*, 17–19 (on 1st January of the year in which the competition is held).—Examination: very similar to that for clerkships (Class I.) in the Home Civil Service. Salaries, a total allowance of £300 for the two years spent on probation in England; on arrival in India, from about 400 rupees per month. Competitions are held once a year.

Student Interpreterships in China, Japan, or Siam, 18–24.—Examination: handwriting and orthography; arithmetic; English composition; précis; geography; Euclid; Latin; French; German; mercantile and criminal law. Salaries, £200, with prospect of promotion in the consular service.

Student Interpreterships for Turkey, Persia, and the Levant, 18–24.—Examination: reading; handwriting and orthography; arithmetic; English composition; French; Latin; ancient Greek; Italian; German; Spanish. Salaries, £200, with prospect of promotion in the consular service.

Cadetships for Ceylon, Hong Kong, and Straits Settlements, 21–24.—Examination: handwriting; orthography; arithmetic; composition and précis; Latin; not more than three of the following languages—Greek, French, German, Italian; pure and mixed mathematics; geography; history; constitutional and international law, and political economy; geology, civil engineering, and surveying. Salaries, Ceylon cadets, 3000 rupees; Hong Kong and Straits cadets, 1200 dollars.

Examinations for Appointments in the Home Civil Service for which a Nomination by the Head of the Department is required.—*Foreign Office—Clerkships*, 18–24.—Examination: arithmetic; handwriting and orthography; composition; précis; French; German; Latin; general intelligence; geography; history of Europe; constitutional history; Italian; Spanish; ancient Greek. Salaries, £200 to £600, &c.

British Museum—Assistants, 18–30.—Examination: writing from dictation; orthography: arithmetic; English composition; précis; geography; English history, or Euclid, or algebra; translation from one ancient and one modern language; any other subjects which the trustees may prescribe. Salaries, £120, rising through grades to £450, &c.

Constabulary Cadets (Ireland), 21–26.—Examination: arithmetic; separate addition; orthography; handwriting; intelligence in dictation; English composition; précis; geography; British history; Latin or French; elementary

law; law of evidence. Salaries, £125, rising through grades to £450.

Prisons Clerkships (England), 20–30.—Examination: handwriting; orthography; arithmetic; copying MS.; composition; indexing; book-keeping; digesting returns into summaries. Salaries, £80, rising through grades to £190.

MILITARY EXAMINATIONS OPEN TO PUBLIC COMPETITION.—*Royal Military Academy, Woolwich*, 16–18.—1, Mathematics, 2, English literature; 3, classics (Latin and Greek); 4, French; 5, German; 6, either Italian, Russian, Spanish, or Hindustani; 7, experimental sciences, viz. chemistry and heat, or electricity and magnetism; 8, general and physical geography and geology; 9, drawing, freehand.

Candidates are only allowed to take four of the above nine subjects, exclusive of drawing.

Royal Military College, Sandhurst, 17–20; for West India regiments, 17–24; students of universities, 17–21; graduates of universities, 17–22.—1, Mathematics; 2 English composition; 3, Latin; 4, Greek; 5, French; 6, German; 7, experimental sciences; 8, general and physical geography; 9, drawing, freehand; 10, drawing, geometrical.

Of the above ten subjects candidates are not allowed to take up more than four, nor less than two, exclusive of freehand and geometrical drawing.

Militia Examinations.—Lieutenants of militia nominated for commissions in the army must pass a qualifying examination on the subjects for the Royal Military College, Sandhurst, before they are allowed to compete among themselves in military subjects.

EXAMINATIONS FOR APPOINTMENTS IN THE NAVY.—*Naval Cadets.*—Limited competition. Nomination required. 12–13½. Arithmetic, algebra, geometry, English, French, Scripture history, elementary mathematics, Latin, geography, and English history.

Engineer Studentships, 14–16.—Open to public competition. Examination: handwriting; dictation; arithmetic; composition; grammar; geography; French, or German, or Italian; Latin; algebra; Euclid; mechanical drawing. Salaries with allowances: engineers rise through grades from £137 to £429, &c. Competitions are held once a year.

Assistant Clerkships, 15–17.—Nomination required. Examination: dictation; letter writing; writing the substance of a chapter read out; French; separate addition; arithmetic; geography and history; Scripture; algebra and Euclid; Latin; German, or Spanish, or Italian; elementary physics; drawing. Salaries with allowances, £45, rising through grades to £420, &c.

The full regulations for all open competitions can be had post free on application to the Secretary, Civil Service Commission, London, S.W.

EX'ARCH (Gr. *exarchos*, a chief ruler) was the title of the governor of Italy under the Byzantine emperors, established by Justinian after the reconquest of Italy from the Goths in the sixth century. The residence of the exarch was at Ravenna. At first the exarchate comprised a large part of Italy, the territory immediately round Ravenna being under the personal rule of the exarch, and the remainder divided into provinces under the control of satraps (called *duces*, or dukes) on the Eastern system. The first actual exarch was Belisarius, who reconquered Italy, but the first to bear the title was his rival Narses. As time went on Venice and Naples shook off the rule of the exarch, and the Goths reconquered outlying territories, so that the exarchate of Ravenna, Romagna, and the coast of Rimini as far as Ancona, alone remained. In A.D. 752, Ravenna being taken by Astolphus, king of the Longobards, the exarchate, as well as the dominion of the Byzantines over North Italy, was at an end. The part which the exarchate afterwards played in the history of the Church of Rome is narrated in the article DONATION.

EXCHANGE, in commerce, is the term commonly employed by merchants to designate the written instrument by means of which the debts of persons residing in different countries, or in different parts of the same country, are brought to a condition for final liquidation; and second, the varying price of such negotiable instruments in the market. The first division of this subject has already been discussed under the title of BILL OF EXCHANGE.

In the consideration of that part of the subject which belongs to the present article, it must be observed that different nations make use of different coins, varying in denomination, metal, weight, and consequently in value. Hence one of the first operations with which exchange has to do is that of finding the equivalent value of the legalized currencies of the different nations. The pound sterling, for instance, is the standard of value for Great Britain, the franc that of France, the dollar that of the United States of America, and these several coins contain very different quantities of the precious metals. Without some common medium of value in commercial transactions it would be impossible for bills of exchange to be drawn between one country and another. This medium is found in gold and silver bullion, and the value of a currency depends upon the quantity of pure metal contained in the coin which forms its legal tender, alloy being left wholly out of the account. In the calculations made to ascertain the equivalency of a certain amount of the currency of one nation in the currency of another for mercantile purposes, it is assumed that the currencies of both are of the precise weight and purity fixed by their respective mints. This equivalency in mercantile language is termed the *par of exchange*. Thus, according to the mint regulations of England and France, the English pound is equal to 25 francs 20 centimes, which is said to be the par between London and Paris. Between two countries using the same metal as the standard of value the calculation of the par is an easy matter, but the case is altered when one nation uses a gold and the other a silver standard, and between these an invariable par cannot exist. In countries where a double standard is employed the silver coinage may have a conventional value in relation to gold, so far as the internal arrangements of those countries are concerned, but for purposes of foreign exchange silver coins become merely a commodity liable to fluctuation with the varying price of silver. Though there exists no invariable par of exchange it is extremely useful to the merchant to know the average value of the currency of every country with which he trades, in order to ascertain what may be called the approximate par, which must be the pivot around which fluctuations will necessarily turn. This approximate par, grounded on the average value of a currency taken on a period sufficiently long to include fluctuations from highest to lowest, is that to which it will be the tendency of the rate of exchange to conform.

The approximate rate of exchange will be liable to be affected by the circumstances of the rise or fall in the price of the precious metals, changes made by a nation in the nature of its coinage, and from the condition of the coinage itself in relation to its proper mint standard. Fluctuations in the rate of exchange proceeding from an alteration in the value of the medium in which price is quoted, are purely *nominal*, and so they are usually designated. Such as are *real* arise from other considerations, and in relation to the bills of exchange depend upon the proportion between supply and demand. Thus, as already stated, the pound sterling of England is equal to 25 francs 20 centimes of French money, and when bills are drawn at this rate in London and Paris the exchange is said to be at par. If we imagine the trade between the countries to be equal, so that each buys of the other goods of precisely the same value, the bills drawn upon one side would exactly balance the other, and the *real* as well as the *nominal* exchange

would be at par. But if the purchases made by England are greater than those of France, there will be a correspondingly increased demand in London for bills on Paris over that in Paris for bills on London, so that the *real* exchange would be in favour of Paris and against London. Of course, in the actual transactions of commerce many things affect the exchange beyond the amount of exports and imports. Freights and transit dues, the public outlay of nations, and the private expenditure of individuals are all paid by means of foreign bills of exchange, and as these pass freely from place to place the deficiency in one centre is balanced by the excess of another. The natural tendency which the exchange has to gravitate towards par is largely assisted by the action of those whose occupation it is to deal in bills. It is the business of these merchants to watch closely the different markets of the world, to buy them in the place where they are cheapest, and to sell them again where there is the greatest demand.

The real exchange also is subject to a limit beyond which it cannot go, and this limit is found in the cost of transmitting the precious metals. If, for instance, one half per cent. were sufficient to cover all the expenses attending the transmission of bullion between Paris and Berlin, it would be indifferent to a merchant of the former city whether he paid one-half per cent. premium for a bill of exchange on Berlin or remitted the money direct, but he would not, under these circumstances, pay a greater premium than one-half per cent. for a bill. In London the trade in bills is carried on by means of brokers, who ascertain from the principal merchants whether they are buyers or sellers of bills. By the brokers a price is fixed, at which the greater part of the transactions are settled, and this price is published. The best bills, however, are generally negotiated on better terms than those given in the official list. (See "The Theory of Foreign Exchanges," by the Right Hon. G. J. Goschen, M.P. London, ninth edition, 1876.)

EXCHANGE, BILL OF. See BILL OF EXCHANGE.

EXCHEQUER BILLS form the principal part of the unfunded debt of this country. These bills are issued under the authority of Parliament for sums varying from £100 to £1000, and bear interest. They were first issued in the reign of William III., and although their amount has since varied greatly at different times, the convenience which they afford to individuals, and their advantage to the public, have been such as to cause their constant issue. Their convenience to individuals arises from the circumstance of their passing from hand to hand without the necessity of making a formal transfer, of their bearing interest, and of their not being subject to such violent fluctuations as sometimes occur in the prices of the funded debt. This comparative steadiness in value is caused by the option periodically given to the holders to be paid their amount at par, or to exchange them for new bills to which the same advantage is extended; besides this, within six months of the date of their expiration they may be paid to the government at par in discharge of duties and taxes. The amount of premium that may have been paid at the time of purchase is consequently all that the holder of an exchequer bill risks in return for the interest which accrues during the time that it remains in his possession. The advantage to the public consists in the lower rate of interest which they carry compared with the permanent or funded debt of the nation, to which, however, they must in this respect bear some certain proportion. When the price of the public funds is high, the interest upon exchequer bills will be low; and if, through any public or commercial derangement, the funds should fall in price so as to afford a much more profitable investment than exchequer bills, the rate of interest upon these must be raised in order to prevent their payment in too large quantities into the exchequer in discharge of duties, a course which would have a tendency to embarrass the financial operations of government. It will be thus seen that exchequer bills are a convenient means whereby the government can meet a sudden demand for unusual expenditure. When it is intended to pay off outstanding exchequer bills public notice is given by advertisement.

EXCHEQUER, CHANCELLOR OF. See CHANCELLOR OF THE EXCHEQUER.

EXCHEQUER COURT was the name of a superior court of record established under the Norman kings of England. The name is said to be derived from *scaccarium*, and at the commencement of its use signified treasury. As to the origin of its application there is much difference of opinion, but most probably it was used because a chequered cloth used to be laid on the table in the chamber where the court sat, chequered meaning, like a chess-board (*scaccus* or *scaccum*), marked in squares. The king's revenue was mainly derived from the contributions levied upon the barons; and as these could only be amerced by their peers, the court was constituted entirely of barons of the realm—hence the title, "Barons of the Exchequer," by which its judges were known even up to 1875. [For the manner in which itinerant justices arose from the needs of the exchequer see EYRE, JUSTICES IN.] For ages the jurisdiction of the court was solely in cases affecting the "king's business and profit," but when in course of time the revenue came to be derived from other than feudal sources, its business as a court of revenue declined. In the meantime, on account of the great increase of civil and criminal business, much of it flowed into the exchequer; and in the reign of Elizabeth the barons of the court were made judges of the realm for the purpose of enabling them to hold assizes as well as to sit at Westminster. From that time the court became one of the regular courts of justice at Westminster; but as a court of common jurisdiction it was of new origin, and so it took rank after the Court of Common Pleas, which had existed as a regular court ever since the Great Charter. Still it was for centuries debarred from taking any business except that which in some way touched the king; and common pleas were forbidden to be heard in the Exchequer by statute in 1282 and 1284 (Edward I.), and by the ordinances of 1311 (Edward II.) The prohibition was evaded in various ways to obtain the benefit of the equitable jurisdiction peculiar to the court. For instance, a creditor would allege that he could not pay the king's taxes, &c., because his debtor kept him out of his money, and on this pretext would get trial of his claim in the Exchequer. The jurisdiction of the Exchequer Court in equity as well as in law was transferred in 1842 to the Chancery Court. It thus became entirely assimilated to the other courts, except that, like the Queen's Bench, it had a peculiar or exclusive jurisdiction—that of revenue. As a distinct and peculiar court its glory had long departed; it had become a mere court of common jurisdiction, like the Common Pleas, and there was, of course, the less reason why it should continue as a separate court. Accordingly, together with the other courts of justice it was, in November, 1875, merged into the one High Court of Justice created by the JUDICATURE ACT. To the Exchequer division of the High Court, however, was still reserved whatever revenue business might at any time arise. Finally, by an Order in Council in 1881, the entire Exchequer division merged into the Queen's Bench division.

Closely connected with the Court of Exchequer was the *Court of Exchequer Chamber*. When the business of the first court was mainly that of the king's revenue, it became the custom for all the judges to assemble with the chancellor to discuss and consult as to cases of great difficulty and doubt, a practice which continued to our own time. These assemblies were originally held in the chamber in

which the Court of Exchequer sat, but in modern times in a chamber distinct from it, although close to it. Such meetings of the judges for purposes of consultation, however, must be distinguished from the tribunal by which appeals from the Court of Exchequer were formerly decided. The only appeal from the Exchequer Court was by writ of error to the justices of Queen's Bench and Common Pleas sitting in the Exchequer Chamber, and thence to the House of Lords.

EXCISE DUTIES. See INLAND REVENUE.

EXCLUSION BILL. When in 1674 it had become quite apparent that Charles II. was at heart a Roman Catholic, the Protestant party, under the leadership of the Earl of Shaftesbury (whose dismissal was, in fact, the last proof needed of the king's real feeling), determined to exclude the Duke of York from the throne. Shaftesbury saw that while it was easy to preserve the ecclesiastical freedom of England with Charles, it would be quite impossible with the morose and bigoted James. A bill was brought in to exclude all Catholics from the court, but it failed. Another sought to enforce "Protestant securities," by means of forfeiting the right of succession to any prince of the blood who should marry a Catholic princess. This was aimed at James's second marriage with Mary of Modena, and failed also. During the power of Danby these designs perforce ceased, indeed Shaftesbury suffered a long imprisonment. On his release Danby was impeached [see DANBY], and to save himself from the exposure of his own perfidy, enacted through Danby's means, the king agreed to recall Shaftesbury and his party to power, and to summon a new Parliament. The result was that the feeling against the Duke of York, which had shown itself so strong even in the long-lived Parliament elected under the enthusiasm of the Restoration (1660–78), was far stronger in its successor. It met in 1679. Its predecessor had passed in its last session the famous bill which till 1829 excluded all Catholics from offices of state. Signal exception was made of the Duke of York. The new House of Commons passed the Exclusion Bill, by a very large majority, expressly to annul this exception, and by name to exclude James, duke of York, as an avowed Roman Catholic, from the crown. The king induced the Lords to reject it. Shaftesbury repeated Pym's tactics under Charles I., and caused a Remonstrance to be prepared in the Commons. Charles dissolved the Parliament and dismissed Shaftesbury. The next Parliament met in 1680, and the Commons at once passed a resolution that they would "suppress popery and prevent a popish successor." Again the king dissolved his Parliament almost as soon as it met, and attended the new Parliament of 1681 at the head of his guards, pretending to fear a tumult, and still under that excuse almost at once dissolved it. The truth was that he had succeeded in obtaining a fresh subsidy from Louis XIV. of France, and was independent of supplies. He never summoned another Parliament. Had he done so, in all probability James II. would never have ascended the throne, for the Exclusion Bill would certainly have become law. In the BILL OF RIGHTS, which granted the crown to the successors of James II. at the Revolution of 1688—William and Mary—the ninth section excludes from the succession those who are either Roman Catholics themselves or who marry a Roman Catholic; and this was repeated in the Act of Settlement passed in 1700, where it forms the first clause. Should such a person obtain the crown the people are declared to be absolved from all allegiance. This is the Act under which the present royal family reigns.

EXCOECA'RIA, a genus of plants belonging to the order EUPHORBIACEÆ. This genus is nearly related to the poisonous manchineel (Hippomane) of South America; but the calyx is more deeply divided, the stamens are free, and the fruit is not a drupe but a three-celled capsule. The greenish flowers grow in catkins, the male and female being generally produced on different trees. There are between twenty and thirty species, natives of tropical and subtropical Asia and Africa, the Mascarene Islands, and Australia. *Excœcaria agallocha* is a small crooked stunted tree, the trunk of which abounds in a virulently acrid milk, which acts as a powerful poison. Roxburgh says that woodcutters who accidentally injure this tree have inflammations and ulcerations on those parts of the body where the milk touches. The natives of Travancore and Cochin call it the Tiger's-milk Tree. The juice affords a kind of caoutchouc; it is used for healing old ulcers. Rumphius calls this tree *Arbor excœcans*, and says that the Dutch sailors who were sent ashore at Amboyna to cut down timber became furiously mad from the pain produced by the juice of this tree getting into their eyes, and that some of them lost their sight altogether. This tree is common in various parts of India and in the Indian islands, especially near the coast. Its specific name appears to have been given it on the supposition that it was one of the plants that yielded the Agallochum, or aloes-wood; but this is not the case, and this wood is yielded by a different family of plants.

EXCOMMUNICA'TION is the highest ecclesiastical censure which can be pronounced by a spiritual judge. The person against whom it is pronounced is for the time excluded from the communion of the church.

All religious bodies have found it necessary to have some means by which offenders against their accepted laws might be punished. Thus the Romans, Druids, and other pagans were in the habit of passing solemn sentences on offenders against their religions, cutting them off from association with orthodox believers, and depriving them of participation in their ceremonies. Under the Mosaic law those who were placed under anathema, or "devoted," as they were called, suffered not only spiritual penalties, but also terrible temporal punishments. and even whole cities were condemned to destruction. In later times the Jewish nation had certainly two degrees of excommunication, and some contend that there were three: the *Niddui*, inflicting thirty days' exclusion from the privileges of worship, with the exception of permission to enter the temple by a door set apart, and prohibition of association with other men; and the *Herem*, involving not only complete exclusion from worship and companionship, but also a terrible curse. The third, with respect to which there is much doubt, is called the *Shammatta*, and was, according to some authorities, the handing over of the offender to the Evil One for eternity.

Several passages in the New Testament form the foundation for Christian excommunication, as in Mat. xvi. 19; xviii. 15–18; 1 Cor. v. 3–5; 1 Tim. i. 20; but the Gospel affords no guide as to the details of the punishment. In very early times there were two degrees of severity in spiritual excommunication, according to the extent of the offence. It was not, however, until the fourth century that excommunication carried temporal punishment as a part of the sentence. From this time, with the increase of the power of the clergy, the greater excommunication carried with it very serious secular deprivations and punishments. The excommunicated person was deprived of all political rights, and was excluded from all public offices as well as from the privileges of the church. In the earliest times the sentence of excommunication had been passed by the church as a body, but during the middle ages the power to pass such a sentence became one of the prerogatives of the bishops and higher members of the clergy, and especially that of the pope. The ritual observed in passing such a sentence became more elaborate and significant of destruction, until at the close of the twelfth century it included "bell, book, and candle." In this service, by an awful symbolism, the bell was tolled for the soul that was dying a spiritual death; the book of books, the Bible, was

violently closed and flung upon the ground, as if its blessings were for ever to be excluded from the guilty one; and the candles were blown out, for the light of grace had been extinguished, and nought now remained but the blackness of spiritual darkness. Not only were living individuals liable to be excommunicated, but whole communities, even nations, were placed under interdict. The frequent use of this power for political purposes, however, tended to bring the practice into disrepute, and it was frequently set at defiance both by rulers and people. The first pope to inflict this penalty on a reigning prince was Gregory V., who excommunicated Robert, king of France, in 998. John and Henry VIII. of England were excommunicated. Napoleon (excommunicated in 1809 by Pius VII.) is also a famous instance. The latest instance of its use in political affairs was that which occurred in 1860 when Victor Emmanuel, king of Italy, was excommunicated by Pius IX. There are still two kinds of excommunication in the Roman Catholic Church—the *lesser*, which simply debars from the eucharist, and the *greater*, which entails total excision from the church. The various churches which arose at the period of the Reformation made but little use of the power of excommunication, though most of them retained the right to use it. The Church of England vests the power of passing this sentence in the hands of its bishops, and until the passing of the Act 53 Geo. III. 127, persons excommunicated could be deprived of many of their civil rights. No civil consequences can now follow upon ecclesiastical offences, except under the sanction of what is essentially a civil court.

EXCRE'TION, in physiology, is to be considered as a part of SECRETION. If the materials which are separated from the blood are used for some ulterior purpose in the body (as the saliva, the gastric juice, &c.), they are termed secretions; if they are separated merely to be thrown out (as the carbonic acid of the breath, the perspiration, urine, &c.), they are termed excretions. Should an excreting organ be atrophied or disturbed in its functions, other excreting organs may partly or altogether supply its place. For instance, if the skin is inactive the kidneys do more work, and the converse is still more frequent. But this is never the case with the secreting organs. Should the mammæ of a nursing mother not secrete milk, no other organ of the body is able to take its place. At present this circumstance and the destination of the products are the only criteria we have of an excreting as apart from a secreting gland. See SECRETION.

The URINE and FÆCES are sometimes termed excreta (or excrement); they are described under their separate articles.

EX'CRETIN, a crystalline substance obtained from human fæces by extraction with alcohol. It is prepared in silky colourless crystals, melting at 95° C. (208° Fahr.) It has an alkaline reaction, and is insoluble in water, but soluble in alcohol and ether. The formula is $C_{78}H_{156}SO_2$.

EXECUTION ON CIVIL PROCESS is the effect given to the judgments and other proceedings analogous to judgments of courts of law in civil suits. The term denotes the process by which a party is put into the possession of that to which the judgment of a competent court declares him to be entitled. Accordingly the judgment is given either to put a party in possession of the thing in dispute, or to enable him to obtain pecuniary compensation. The enforcing of a judgment or order of a court is effected by *writ of execution*, or final process, addressed to the sheriff, who is said to execute the writ when he carries out the command thereby given him.

Between the original parties to a judgment execution may issue at any time within six years from the recovery of the judgment. A writ of execution when issued remains in force for one year only, but if unexecuted during the year it may be renewed before its expiration by leave of the court or a judge for another year, and this renewal may be repeated from time to time as may be necessary.

By a writ of *fieri facias* (usually abbreviated *fi. fa.*) the goods and chattels of a refractory debtor may be attached. Formerly only wearing apparel in actual use was exempt from seizure, but now wearing apparel, bedding, and tools and instruments used in trade, to the total value of £5, are protected from seizure under any execution. In the execution of the writ *fi. fa.* the sheriff is not empowered to break open an outer door to obtain admission to the debtor's house, but having entered the house by the open door, he may break open any inner doors in his search for goods. If the goods have been removed to another house or building to avoid execution, and their delivery is refused, he may break open the outer door in order to seize them. When goods have been seized in execution any arrears of rent and queen's taxes due for a period of not more than one year must first be paid. In every case of execution the necessary fees and expenses may be levied over the amount of the judgment. If the goods seized are insufficient to satisfy the debt a new execution may be issued for the residue, or an *elegit* may be obtained. The effect of a writ of *elegit* (so called because the creditor could choose between this writ and the writ *fi. fa.*) is to give the judgment creditor legal, though not actual, possession of the lands and tenements of the judgment debtor, to be held by him until the money due on such judgment is fully paid.

Formerly a writ *capias ad satisfaciendum* (abridged generally to *ca. sa.*) was issued, which gave the creditor power through the sheriff to seize the person of the debtor and hold him in prison until the debt was satisfied, but since the Debtor's Act of 1869 imprisonment for debt has been abolished, except in such cases as are specified in the Act. The chief exception is that where a debtor, having means, refuses or neglects to pay after an order for payment under the Debtors' Act has been made. He may then be imprisoned for six weeks, and such imprisonment is no satisfaction for the debt, which may be recovered by execution in the usual way, as if no such imprisonment had taken place.

In Scotland the analogous writs go under the name of *diligences*. Of these inhibition and adjudication apply to real estate, arrestment and poinding to personalty. Inhibition and arrestment secure the debtor's belongings under judicial control; by adjudication and poinding they are made directly available to the creditor in pursuance of his judgment when obtained. This may also be done by a forthcoming following on an arrestment. The Scotch law thus not only affords most effective means of rendering all the belongings of a debtor available to his creditor on obtaining judgment, but enables a plaintiff in the course of his action to tie them up in security of a decree not yet obtained. This latter power is often most beneficial, but it is also liable to great abuse; and though it may be limited by application to the court, has too often been employed oppressively and for the purpose of forcing a compromise of doubtful claims. Caption is the Scotch *ca. sa.* But as imprisonment for civil debts has recently been abolished by statute, this form of diligence is now available only for recovery of alimentary debts and taxes, and to compel implement of decrees for specific performance—these being excepted from the operation of the statute.

EXECUTION. See CAPITAL PUNISHMENT.

EXECUTIONER is the official who carries out the sentence of death. It is the province in England of the sheriff to perform this duty, but he deputes the task to the hangman, and attends to see the law carried out. At one time almost every county town had its executioner, with a salary for his maintenance; but now most places in Great Britain choose the most suitable person, who is hired for the occasion. In former times the office

of public executioner was frequently held as a hereditary right, or as attached to certain official positions. The appointment has also been conferred on prisoners under the sentence of the law, as in the case of John High or Heich, the Edinburgh executioner from 1784 to 1817.

In France the public executioner is generally called Monsieur de Paris. In the United States the function is performed by the sheriff, assisted by an under-jailer.

EXEC'UTOR. An executor is he to whom another person commits the execution of his will. The origin of executors seems to be traceable to a constitution of Manuel Comnenus (*peri dioikētōn tōn diathēkōn*). All persons who are capable of making a will, and some others besides, as married women and infants, are capable of being made executors; but infants are incapable of acting in the execution of the will under the age of twenty-one.

An executor derives his office from a testament alone. If no executor is appointed by the will administration is granted by the court, with the will annexed, and the administrator is bound to obey the directions of the will. An executor may decline to act; but, having once acted, he cannot divest himself of the office or its liabilities; nor can an administrator who has accepted the office get rid of his responsibility.

The first business of an executor is to prove the will, which must be done before the legally appointed court within six months of the death of the testator. The court furnishes him with a probate, or approved copy of the will, which is his authority for acting. The original will is deposited in the registry of the court. An executor may do many acts in execution of the will before probate, as paying and receiving debts, &c., but he cannot, before probate, sustain actions or suits. An administrator can do nothing till the letters of administration are issued. If an executor die before probate, administration must be taken out to his testator, with the will annexed; but if an executor die after having proved the will, his executor will be the executor and representative of the first testator, unless, before proving the will of the second testator, he renounces the execution of the will of the first. If the executor dies intestate, his administrator is not the representative of the testator, but an administrator *de bonis non*, as it is termed, of the testator must be appointed by the ordinary. If there are several executors the office survives, and is transmitted ultimately to the executor of the surviving executor, unless he dies intestate. Executors have a joint and entire interest in the effects of their testator; any one of them is capable of acting by himself; and the receipt of a debt, or the transfer of property by one, is as valid as if it had been done by all.

If a stranger acts as executor without authority, he is called an executor *de son tort* (of his own wrong), and has all the liabilities of an executor without the advantage. But the only advantage which an executor derives from his office is the right to retain any debt due to him from the testator, as against creditors of equal degree.

The duties of executors and administrators are in general the same—to bury the deceased, to prove his will (which of course only an executor has to do), to get in his goods and chattels, to pay his debts in the order appointed by law, and also his legacies, if he has bequeathed any, and to dispose of the residue of his goods and chattels in the manner directed by the will, or according to the statutes for the distribution of the effects of intestates, if there should be a total or partial intestacy. Executors and administrators are liable to an action at law, and also to a suit in equity, for the payment of the debts and liabilities of their testator or intestate, and for the legacies bequeathed by him, and the due administration of his estate; but no action at law lies for a legacy until after the executor has acknowledged the sufficiency of the assets after providing for the payment of the debts.

It appears to have been a subject of much controversy whether the probate of wills was originally a matter of exclusive ecclesiastical jurisdiction; but whatever may have been the state of the law in earlier times, it is certain that until the passing of the 20 & 21 Vict. c. 77, the ecclesiastical courts were the only ones in which, except by special and long-established prescription, the validity of wills of personalty could be established or disputed. By that Act the ancient jurisdiction of those courts in matters of probate and administration was transferred to a new court, thereby established and styled the Court of Probate —now known as the Probate division of the High Court of Justice.

Formerly the personal estates only of persons deceased were liable for the payment of their simple contract debts; but now, since the statute 3 & 4 Will. IV. c. 104, real estate is liable for the payment of debts of that nature. The personal estate is liable in the first instance, unless the testator direct otherwise. Estates descended are applied before estates devised; and in other respects the estates of the deceased are administered in the order laid down by the courts.

In Scotland an executor is the legal administrator of the movable estate of a deceased person, and is charged with its collection and distribution among all concerned in accordance with law. If nominated by the deceased he is termed executor nominate, if appointed by the court he is styled executor dative. In both cases he must obtain confirmation by the court as his title to administer. Applicants for the office are preferred in the following order: 1, Executor nominate; 2, universal disponees; 3, next of kin; 4, the widow; 5, judgment creditors; 6, special legatee. All executors must find security for the faithful discharge of their office, except executors nominate. In some cases the administration is committed by the court to a judicial factor. Executors are responsible only to the extent of the inventory to which they confirm. In most respects the rights, duties, and liabilities of Scotch executors are the same as those recognized in England; though differences in some points may be traced, they cannot be here adverted to (see Maclaren "On Wills").

EXEGE'SIS (derived from the Greek word *exēgeomai*, to lead the way, to interpret) is the art or science of discovering the true meaning of any writer, but the use of the term is most generally limited to an examination of the Scriptures. Theoretically the exegete should be a complete master of the language and circumstances in which the original writer composed, so that he may be, in fact, in a position to think exactly as the author did; but as this is not possible in practice, various names have been given to different methods of pursuing the art, according as the subject was approached with a mystical, grammatical, or historical bias. In ancient times the method called the *allegorical* always held a high place. By this method a secondary or spiritual meaning, not apparent in the plain written words, was attached to every passage, which meaning it was the business of the commentator to discover and explain. In modern times exegesis has had a peculiarly powerful attraction for the minds of some of the best German writers, who have attacked the subject in what seems to some an irreverent spirit, but with great ability. Among such writers may be mentioned Kant, who concludes to accept from Scripture only such notions as are confirmed by the supposed pure principles innate in the human breast; Paulus and Eichhorn, who assert that when all the misconceptions of narrators are removed, and all subsequent additions, the true remainder may be explained by the ordinary processes of nature; Strauss, who considers that much of the Gospel account is of a mythological character. There are also many other writers who place the Scripture on a level with any ordinary classic. As might be expected England has produced some able

exegetes, and important contributions have been made to the science in modern times by the labours of Dean Alford, Dean Stanley, Conybeare and Howson, Tregelles, Davidson, Robertson-Smith, Jowett, and others.

EXE'TER, a city and a county of a city, parliamentary and municipal borough and port, about 8 miles from the English Channel, 44 miles N.E. from Plymouth, 168 miles W.S.W. from London by road, or 194 miles by the Great Western and Bristol and Exeter railways, and 171 by the London and South-western.

Exeter is supposed to have been a settlement of the Britons before the Roman invasion. By the Romans it was called *Isca Damnoniorum*, to distinguish it from the *Isca Silurum* in Wales. From the number of coins, small bronze statues, tesselated pavements, and other Roman antiquities discovered near the walls and in the neighbourhood of the city, it must have been a Roman station of some importance. In the reign of Alfred the town had acquired the name of Ex-an-Ceastre (castle on the Exe). An abbey was founded by Athelstan here in 932, and soon after so great was the number of religious establishments that the ecclesiastics called the town *Monketon*. Harold's mother, Gytha, held the town against William the Conqueror, but it was stormed in 1068. It was held in great favour by the Tudor monarchs, and Elizabeth conferred on it the title of *semper fidelis*. The declaration of William III. on arriving in England was read by Burnet in the cathedral here in 1688.

Exeter is situated on a steep acclivity on the north-eastern bank of the river Exe, over which is a handsome stone bridge, leading to the suburb of St. Thomas. The streets were formerly narrow, but of late years they have been considerably improved, and there are now also some handsome squares and terraces, which contain many well-built houses. A complete system of drainage has also been carried out, and an ample supply of water obtained.

Exeter was in ancient times strongly fortified, and much of the exterior wall, in a ruinous state, still remains; a part of the rampart has been converted into a public walk. The city, exclusive of the suburbs, is a mile and a half in circumference. Situated on a high eminence, on the north side of the town, are the ruins of the castle, called Rougemont, from the red colour of the rock on which it stands. It was either rebuilt or repaired by William the Conqueror. It continued to be an important fortress till it was completely dismantled during the Civil War. In the area of the castle-yard a session-house has been erected, a neat-looking building faced with Portland stone, which contains, in addition to two courts, a grand-jury room, magistrates' room, &c. In front is a fine open space, where county, election, and other meetings are held. Nearly in the centre of Exeter is the guildhall, where the assizes for the city are held, as well as the sessions, elections, &c. The building was carefully restored in 1864. It is uncertain when Exeter Cathedral was first built, but probably it was soon after the see of Devon was transferred to Exeter from Crediton, in 1049. It was considerably altered and enlarged by Warlewast, third bishop of Exeter, who was a Norman and came over with the Conqueror. It then assumed its present cruciform shape, but it underwent numerous alterations and additions during the thirteenth and fourteenth centuries. It now consists of a nave, 76 feet in width and 175 in length, with aisles; two short transepts, formed by two Norman towers 130 feet in height; a choir of the same width as the nave, and 128 feet in length; ten chapels or oratories, and a chapter-house. The whole building from east to west (including St. Mary's chapel) is 402 feet in length. The western front is highly decorated with a profusion of niches and carved figures, and presents an exceedingly rich façade. The towers are highly interesting specimens of Norman architecture. The north tower contains the great Peter bell, brought from Llandaff by Bishop Courtenay, 1478–86, recast just 200 years later, 1676, and weighing 12,500 lbs. The interior is also exceedingly fine; the vaulted roof of the nave is supported by clustered columns, surmounted by pointed arches, as is also that of the choir, which is separated from the nave by a screen of beautiful workmanship. The chapter-house is a fine edifice, with a handsome oak roof. Extensive restorative works were carried out under the late Sir George Gilbert Scott from 1870 to 1877.

Exeter comprises nineteen parishes and three extra-parochial places. One of the most recently erected churches is that of St. Michael and All Angels, on St. David's Hill. It is quiet in character but admirably finished, and is noteworthy for an east window of superior design, and a spire in imitation of that of Salisbury Cathedral, 233 feet high, forming, from the elevated site on which the church stands, a conspicuous object in a general view of the city, and rising far above the towers of the cathedral. There are a large number of places of worship for different denominations of dissenters. The Devon and Exeter Hospital is supported by subscription, and has also a considerable income arising from funded property. There are a lunatic asylum, a dispensary, an eye infirmary, an institution for the deaf and dumb, a female penitentiary, savings bank, school of art, the Albert Memorial Museum, post-office, bankruptcy court, &c. The Albert Museum makes provision for the local museum, school of art, and free library, all three very flourishing institutions. The workhouse forms a large range of buildings, and affords accommodation to several hundred paupers. Statues have been erected of Sir Thomas Dyke Acland, Bart., also of Earl Fortescue, the Earl of Devon, and of Mr. John Dinham, a distinguished local philanthropist. St. John's Hospital now consists of a free grammar-school, blue-coat, and commercial schools. At Hele's Commercial School, built in 1850, and supported from part of the revenues derived from an estate left by Elize Hele, in 1632, boys belonging to the city are also well educated on payment of a small annual fee. There are also several minor charity schools, and a large number of almshouses. The Devon and Exeter Institution for the Promotion of Arts, &c., has a library which contains about 15,000 volumes, and is regularly supplied with modern publications and newspapers. The theatre is a neat building. To the north of the city is the county gaol, which is judiciously planned, and contains the governor's and chaplain's residences, chapel, &c. The assizes are held by the judges of the western circuit twice a year.

Owing to the fertility of the surrounding country, Exeter has long been noted for its cheap and well-supplied markets. It has now two handsome and spacious market-places.

The manufacture of woollen goods was at one time extensively carried on in Exeter, but it is now extinct. Honiton lace is made here and in the neighbourhood, in the manufacture of which the operatives are very clever. There are also large iron-foundries, manufactories of agricultural implements, paper and corn mills, breweries, malthouses, and tanneries in the town. The port has a miscellaneous trade. By means of a canal, with sluices and flood-gates, vessels of 400 tons burden can come up to the quay near the city walls.

The number of vessels registered as belonging to the port is fifty (7000 tons). The entries and clearances average 800 (70,000 tons) per annum. The customs revenue averages £180,000 per annum.

The municipal borough is divided into six wards, and is governed by fourteen aldermen and thirty-six councillors (of whom one is mayor). Population, 37,665. The parliamentary borough, which returns one member to the House of Commons, in 1881 comprised a population of 47,154. The number of electors on the register in 1887 was 7000.

The elevated position of Exeter has given it a high character for salubrity and cleanliness, and it is a great attraction to the antiquary as well as the lover of the picturesque. Victoria Park, formerly Berry Meadow, is laid out with taste, and used as a place of public recreation, and few towns in England possess a finer promenade than Northernhay, at the back of the sessions house.

Exeter is the seat of a bishopric which comprises the county of Devon. Bishop Philpotts founded, at his own cost, a Western Theological College in the city, of which the dean is principal.

EXETER COLLEGE, Oxford, was originally founded in 1314 by Walter de Stapleton, bishop of Exeter, who was some time lord high treasurer of England, and it was then called Stapleton Hall. The bishop removed hither his scholars from Hart Hall, and made a foundation for a rector and twelve fellows. In 1404 Edmund Stafford, bishop of Exeter, added two fellowships from the diocese of Salisbury, and obtained leave to give the college its present name. In 1565 Sir William Petre added eight fellowships. Charles I., in 1636, annexed one fellowship for the islands of Jersey and Guernsey. Lastly, Mrs. Shiers, who died in 1700, left certain rents, out of which two fellowships were founded for the counties of Hertford and Surrey. These arrangements were amended in the year 1855, under powers granted by the Act 17 & 18 Vict. c. 81. The fellowships were reduced from twenty-five to fifteen, and are now open without any preference in respect of birth. From the revenues of eight suppressed fellowships twenty-two scholarships are founded; and several exhibitions are attached to the college.

The front of the college, which is opposite Jesus College, extends 220 feet, with a large central gateway, consisting of a rustic basement, from which spring four pilasters of the Ionic order, supporting a semicircular pediment, crowned by a balustrade. The greater part of this front was renewed in 1835 with Bath stone. The hall was erected by Sir John Ackland in 1620. The chapel, begun in 1622-23, was completed by Dr. George Hakewell, afterwards rector. A more elaborate Gothic chapel, on the model of the Sainte Chapelle, Paris, and a handsome library, were erected under the superintendence of Sir G. Scott in 1857. The chapel is remarkable for its fine vaulted stone roof, marble shafts, and exquisite finish, and the library for its elegance and convenience.

There are fourteen benefices in the patronage of the college. The Bishop of Exeter is the visitor. (*Oxford University Calendar*, 1884.)

EXETER HALL, a large building on the north side of the Strand, London, is the headquarters of the Young Men's Christian Association, and is used for religious assemblies and for the May Meetings of religious societies. It is also used as a concert and lecture hall, and has an orchestra capable of accommodating 700 performers. The large hall is 131 feet long, 76 feet wide, and 45 feet high, and will hold upwards of 3000 persons.

EXHIBITION, at a university in England, is somewhat akin to a bursary in Scotland. It really means an allowance of commons, a maintenance during the time of study. It is derived from the Latin verb *exhibere*, in the sense of to maintain. The word exhibition was formerly not uncommonly used in the sense of this article, though it now only survives in academic usage; for in Shakspeare we find—

> "I crave fit disposition for my wife,
> Due reference of place, and *exhibition*."
> —"*Othello*," 1. 3.

EXHIBITIONS, NATIONAL AND INTERNATIONAL. Exhibitions of industry and art have now had an existence of more than a century, and have become, as it were, established institutions. In 1756 the Royal Academy first began its picture exhibitions, and the Society of Arts offered prizes for improvement in the manufacture of tapestry, carpets, porcelain, &c., and exhibited the articles which were offered for competition. In 1761 an exhibition of machinery was held in the society's rooms, and a duly qualified person appointed to explain the models. A few years afterwards France founded the first of that long and successful series of national exhibitions, which were not made international in that country till 1855. The earliest was projected in Paris in 1798, at the suggestion of the Marquis d'Avèze, and was held in the Maison d'Orsay: its grounds remained open three days, and the exhibitors numbered 110. The second took place in 1801, when there were 229 exhibitors; and a third was opened by the first consul, Napoleon, in 1802, when the number increased to 540, and their productions showed an extraordinary improvement in every way. In 1806 the fourth French exhibition was held, and was supported by the largely increased number of 1422 exhibitors. The fifth, in 1819, was in the Louvre, and a marked improvement in many branches of popular manufactures was manifested. Others followed at intervals of about five years up to 1855, with increasing success and grandeur of display.

In the meantime other countries had followed the example of France, and before the year 1840 Austria, Spain, Piedmont, Portugal, Sicily, Prussia, Holland, Denmark, Sweden, and Russia, had held their occasional exhibitions. In 1841 a very successful Belgian exhibition was opened in the Musée de l'Industrie at Brussels.

The progress of these institutions in England during the early part of this period was not by any means so marked and steady. In 1828 an exhibition, under the patronage of George IV., was established at the Royal Mews, Charing Cross, but it was coldly received by the public, and much prejudice was excited against it. From the year 1829 the Society of Arts frequently collected in the old rooms in the Adelphi specimens of raw materials, manufactures, and new inventions, for the instruction of its members and the public. Then followed local trade exhibitions, held at Manchester, Birmingham, Leeds, Dublin, and other places; also the exhibition of manufactures at the Free Trade Bazaar, held in Covent Garden Theatre in 1845. At this time his royal highness, the late Prince Consort, was president of the Society of Arts, and to him belongs the merit of suggesting that the society's exhibitions should be thrown open to all nations, thereby originating international exhibitions.

In 1849 a meeting was held at Buckingham Palace, when the prince suggested plans for raising the necessary funds for carrying out the project, and pointed out the site in Hyde Park which afterwards contained the renowned Crystal Palace of 1851. A royal commission was nominated, with Prince Albert as its president, to effect the object. Subscriptions to the amount of £70,000 were raised in various parts of the country as a guarantee fund. The edifice, planned by Sir Joseph Paxton, and constructed by Messrs. Fox and Henderson, of glass and iron, at a cost of £150,000, was 1851 feet long by 456 feet broad, and 66 feet high, the entire area roofed over being $18\frac{1}{4}$ acres. The decoration of the building was intrusted to Mr. Owen Jones. The exhibition was opened by her Majesty the queen on the 1st of May, 1851, in the presence of 25,000 spectators. The estimated value of the articles exhibited (excluding the famous Koh-i-noor diamond) was £1,781,929, and the exhibition was open 144 days, being closed on the 11th of October. The number of visitors was 6,063,986, being a daily average of 42,111. The greatest number present on any one day was 109,760 on 8th October. The total receipts amounted in round numbers to £506,000, and the expenditure to £330,000. The surplus was devoted to the purchase of the Gore House estate, the Villars estate, and some other adjacent land at South Kensington, in all 86 acres, upon which it was intended eventually to

bring together all existing metropolitan institutions of science and art, and to establish a central point of union for those who devote their energies to the practical application of science and art to productive industry. The idea has been carried out to a large extent, and would doubtless have been so more completely had not the site been so far westward. The 1851 exhibition building, in many respects greatly improved, now stands as the Crystal Palace at Sydenham, and is the most beautiful and attractive of our permanent national exhibitions. The importance and success of this celebrated exhibition naturally encouraged the repetition of such displays all over the world. One was held in Cork in 1852, the first for which any special building was erected in Ireland. Another followed at Dublin in 1853, which, by the princely munificence of Mr. Dargan, was an admirable display, and held in a building of great beauty. It comprised a central hall, 425 feet long, 100 feet wide, and 105 feet high, with smaller halls and galleries on every side. The result was financially unsuccessful, and Mr. Dargan suffered a very heavy loss.

In the same year a similar exhibition took place in a Crystal Palace in New York. The building was of iron and glass, in the form of a Greek cross, about 400 feet in each direction, with arms 150 feet wide. In the centre was a circular space 100 feet in diameter, covered by a dome. The opening was delayed from May to July, and the arrangements were not finally completed till September. It remained open 119 days; the expenses amounted to £200,000, and the receipts to only £70,000.

France, in 1855, tried the experiment of an international exhibition, the whole cost of which was borne by the government. The building was constructed in the Champs Elysées, and though more costly was not so well suited as the Hyde Park palace; but the contents were of the choicest description, and the arrangements reflected the highest credit on French taste and skill. This exhibition was open for six months; the number of visitors was 4,533,464, of whom 40,000 were British subjects. The rate of admission on Sundays was twopence, on other days tenpence, but it was sometimes opened free. The receipts were £118,000.

After this great international display came the Manchester Fine Art Exhibition in 1857, a collection of ancient and modern pictures and works of art never before equalled. More than 20,000 articles of ornamental art were collected together of incalculable value. In its general plan the building was a parallelogram of 600 feet by 200 feet, covered an area of 130,000 square feet, and cost £30,000. In 1861 a very successful exhibition was held at Florence, and was the best that Italy has yet produced. The objects were divided into four classes—Industrial, Fine Arts, Agricultural, and Horticultural.

The second International Exhibition held in London was opened 1st May, 1862, under the auspices of the Society of Arts. The building was erected on the estate at South Kensington acquired by the commissioners of the previous exhibition. Considerable care was devoted to the fine arts department, that being the leading untried feature in connection with English international exhibitions. The building, which was designed by Captain Fowke, R.E., covered about 16 acres, was rectangular in shape, and measured 1200 feet by 560 feet. It was intended to be permanent, and therefore built of brickwork, supported by cast-iron columns. At the intersection of the nave and transept were two enormous glass domes. The total cost amounted to £430,000. The picture-gallery, round the front and sides, was nearly half a mile in length; the nave and transepts were 100 feet high and 85 wide; and the domes were the largest ever built, being 160 feet in diameter and 250 feet high. There were 22,000 exhibitors, of whom 5000 were foreigners. The total number of visitors from the 1st of May to the 1st of November, being 159 open days, was 6,110,869, and the receipts about £500,000. The guarantors were not called on, but no surplus remained.

In 1865 another exhibition was held in Dublin, and was the most important ever held in Ireland. The collection of works of art was unusually fine, and so great was the demand for space for exhibition that 35 acres instead of 5 could have been covered. Financially, however, the exhibition was a failure; and the number of visitors was lessened from 1,150,000 in 1853 to 900,000 in 1865.

In 1867 the largest, finest, and most costly exhibition ever held up to that time took place in Paris. The building was erected in the Champ de Mars, and, with the surrounding gardens, occupied the enormous space of 37 acres. It was of an elliptical form, arranged in twelve concentric circles, with a small open central garden. Each circle was devoted to the exhibition of some special class of articles from all nations, which thus afforded visitors interested in any particular production an admirable opportunity of inspecting it under the most favourable conditions. Outside the outer circle were ranged practical illustrations of the food department in the shape of restaurants of all nations, and in the garden surrounding the building were actual examples of domestic and palatial architecture of most countries, and various kinds of civil and military erections of general importance. The exhibition remained open six months, and was highly and deservedly successful as regards the number of exhibitors and visitors, there having been 50,000 of the former and 8,805,000 of the latter. The expenses of the building and the exhibition generally amounted to over £800,000. The contributions by the state and the municipality of Paris amounted to nearly £500,000, and the admission money, royalties, &c., to £420,000.

In 1871 the first of a series of intended Annual International Exhibitions took place in London. Their interest, however, gradually wore off, and they were discontinued after 1874. Trading was so far allowed that the exhibitions partook of the character of a gigantic shop; while the attempt to make them the medium of popular education signally failed, and vitiated the whole enterprise.

In 1873 an exhibition on a very grand scale took place in Vienna. The situation of the building was admirable, lying in the heart of a park unsurpassed for beauty by any in Europe, the Prater. The area apportioned to the exhibition was between 4 and 5 English square miles, the covered space being considerably more than that roofed in at the Paris Exhibition of 1867. One chief feature of the building was a rotunda, which rose from the centre and divided the main gallery in the middle. There were twenty-six groups of articles exhibited, some of them unique in character, such as cottages and peasants' houses, with their interior fittings and arrangements. The exhibition was open 186 days, and the number of visitors was 6,740,500, from whom £206,478 was received for admissions.

In 1876 came the turn of the New World for an exhibition. In that year the Americans celebrated the hundredth anniversary of the Declaration of Independence; and as international exhibitions are assumed to be the material expression of human fraternity and goodwill, this was considered the most appropriate event with which to commemorate the centennial occasion. The Americans set to work with characteristic energy, the place chosen for the imposing spectacle being Philadelphia, the cradle of the great republic, the city in which the representatives of the Thirteen Colonies met. Here, traversed by the Schuylkill River, is Fairmount Park, a vast pleasure-ground of 2740 acres, on which the city of Philadelphia had already spent 6,000,000 dollars, and in this magnificent tract the exhibition was held. The grounds set apart for it covered 240 acres, besides other inclosures for displays of horses and general cattle. At Vienna the area was 260

acres, including the space for horses and cattle. The buildings at Vienna gave about 2,000,000 square feet of ground-floor surface for exhibitors, and covered 42 acres. At Philadelphia there were 50 acres of buildings, giving 2,107,000 square feet of surface; and this large space was nothing like sufficient for the enormous number who wished to exhibit. Such comparisons will serve to show the scale on which the exhibition was planned. It was larger than that of Vienna, although Vienna had surpassed everything that had gone before. The main exhibition was a parallelogram, 1880 feet long, 464 feet wide, and with an area of 21½ acres. The Memorial Hall, a permanent building, 365 feet long, 210 feet wide, and with a dome 150 feet high, served as the art gallery of the exhibition. The attendance exceeded that at any previous exhibition, amounting in the total to 9,789,392.

An international exhibition of colossal proportions was held in the Champ de Mars, Paris, in 1878, and was visited by 16,032,725 persons, or an average of about 82,000 per day for the six months during which it was open.

Exhibitions connected with special subjects have become frequent of late, as exemplified by the series commenced in London in 1883 with the Fisheries Exhibition, and followed by those of objects connected with Health, Inventions, and Musical Instruments, and finally, the Colonial and Indian Exhibition of 1886. Local exhibitions have also taken place in various provincial towns, some of them in celebration of the Queen's Jubilee in 1887.

EX'ILE, now so rarely used as a punishment, except among the less civilized nations, was in old times the ready and general punishment of a political offender. In Greece facilities of flight were great, owing to the smallness of the separate states; if therefore a criminal was found to have fled before condemnation, his return was formally interdicted. A second and more important form of exile was the famous Ostracism, elsewhere described, by virtue of which any citizen, even for the sole crime of an excessive popularity which might tend to become dangerous, could be driven into exile by the vote of his fellow-citizens. Ostracism was tolerably frequent at Athens, as students of Greek history are aware. The last form of Greek exile was that whereby, in the many changes of power, the losing side was compelled to fly the state. Asia Minor and Italy became as Greek as Greece itself through the crowds of refugees who settled there among the Greek colonies; and Persia, or later on Egypt, had always a crowd of Greek exiles ready to do service at the court of its kings.

In Rome, under the republic, exile did not exist as such. We read repeatedly of citizens being "interdicted from water and fire" by the decree of a magistrate or by a plebiscitum of the people in comitia assembled. The condemned one might if he chose remain at Rome, but it was as an outlaw and one whose life was at every man's mercy. Consequently as a rule the interdicted person voluntarily became *ex sul* (*ex*, *sol*, a wanderer from out the land), and withdrew to some friendly city. He rather evaded punishment than received it. Frequently limits were fixed on the interdict, which thus approached to true exile. Thus Cicero is interdicted from fire and water for a circle of 400 miles round Rome.

Under the empire exile (*exilium*) became a fact, invariably necessitating banishment, loss of citizenship, and degradation. Previously, unless a man chose to become a citizen of a friendly state which held the "right of exile" with Rome, he did not lose his Roman franchise; this was now altered. In consequence a milder form of exile was necessary, and received the name of *relegatio*. Relegated exiles were not degraded though they were disgraced. Thus Ovid carefully declares Augustus only banished him without exiling him:—

"Nil nisi me patriis jussit abire focis."

The severe penalty of exile was called *deportatio*, and the deportate was conveyed to his destination, frequently an island, in chains or in some other publicly degrading manner. On the other hand, the relegate merely received the order to withdraw to a certain place and await the sovereign's pleasure. See Banishment.

EX'MOOR, a high wild tract of moorland in the west of Somerset and north and north-east of Devon. Its scenery, so beautifully described in the novel of "Lorna Doone," is most romantic. For miles the eye ranges over high rolling uplands, cleft by many a deep long glen, broken by rounded hills and sweeping hollows, and dotted by wood and copse. Here, in the second half of the seventeenth century, the famous robbers, the Doones, who kept the country round so long in terror, had their stronghold, and fear and superstition have peopled its wastes with ghostly inhabitants. It is traversed by the rivers Exe and Barle, which with other streams abound in fish. Exmoor is the last refuge of the wild red-deer in England, and it is hunted from the 12th August to the 8th October, affording real sport, for the stags are thoroughly wild. The breed of Exmoor ponies is famous for hardiness. Though still retaining its wild and barren character, Exmoor is not altogether uncultivated, for in a deep ravine at Simonsbath there is a small settlement with about forty farms, and some iron mines are worked.

The rocks belong to the Devonian series, and are mainly slates and sandstones. The highest point is Dunkerry Beacon in Somerset. It is 1668 feet in height. The total area of the tract is about 14 square miles.

EX'MOUTH, a watering-place and market-town of England, in the county of Devon, situated at the mouth of the Exe, 9 miles S.E. from Exeter, and 182 from London by the South-western Railway. The town stands at the base and on the slope and top of a hill rising from the sandy estuary of the Exe. It has a ball-room, baths, and libraries, and the extreme beauty of the surrounding scenery, with the mildness of the climate, still renders it a place of resort, although not to so great an extent as before the rise of Torquay. A market-house, 120 feet long by 60 feet wide, was erected by the Hon. Mark Rolle, and forms a prominent feature. There are some docks on a small scale, but sufficient for the port. Beacon Hill, near the town, commands one of the finest views in England. Exmouth in early times was a place of some importance, and in 1347 its contribution to the expedition against Calais consisted of ten vessels.

EX'OCETUS. See Flying-fish.

EX'ODUS, THE BOOK OF, is the second of the Pentateuch, or Five Books of Moses, and derives its name from the principal event recorded in it, namely, the departure of the Israelites from the land of Egypt, which in the Greek Septuagint translation is expressed by the word *exodos*, that is, a going out. The Book of Exodus records the slavery and cruelty endured by the descendants of Israel (Jacob) under the kings of Egypt; the birth, exposure, and preservation of Moses; his flight into Midian; his divine mission to Pharaoh; the miracles performed by him and his older brother, Aaron; the ten plagues inflicted on the Egyptians; the institution of the Passover; their miraculous passage across the Red Sea; the destruction of the Egyptian army; the journeyings of the Israelites in the Arabian desert; their murmurings against God and Moses; their resumption of the Egyptian worship of the calf under the direction of Aaron, and their consequent punishment; the promulgation of the law from Mount Sinai; and the erection of the tabernacle or portable temple.

The period embraced by the history of this book is usually reckoned at 142 or 145 years, which are calculated thus:—From the death of Joseph to the birth of Moses, sixty or sixty-three years; from the birth of Moses to the departure out of Egypt, eighty years; and from the departure out of Egypt to the erection of the

tabernacle, one year. Nearly the whole of the book is occupied in the detail of circumstances which occurred in the last year of the entire period.

The genuineness and authenticity of the Book of Exodus have been disputed by several modern scholars, and many of the questions raised are still awaiting a satisfactory solution. It is generally admitted that in the earlier chapters of the book distinct traces of the Elohistic and Jehovistic documents, which form the basis of the preceding Book of Genesis, are to be found, but the most orthodox critics admit that Moses may have made use of earlier traditions, both written and oral, in the composition of his work. More serious difficulties are found in the dates and statistics given and in the miracles recorded, such as the signs given by Moses and Aaron, the plagues of Egypt, the passage of the Red Sea, the giving of the manna, &c.

The opinion that the Book of Exodus is not the work of Moses has been maintained by Aben Ezra Maimonides, Le Clerc, Dr. Middleton, Newton, and among later scholars by Von Lengerke, De Wette, Knobel, Colenso, and many others, the opposite view being sustained by Hengstenberg, Havernich, Rauhe, Welte, and Keil. See PENTATEUCH.

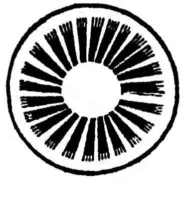
EX'OGENS or **DICOTYLEDONS,** the largest primary class in the vegetable kingdom, are so named in consequence of their woody matter being augmented by additions to the *outside* of that which is first formed near the centre. As long as they continue to grow they add new wood to the outside of that formed in the previous year, in which respect they differ essentially from ENDOGENS or MONOCOTYLEDONS. As the word endogen does not well describe the formation of wood in that class, the word monocotyledon has been substituted for it, and consequently the corresponding term dicotyledon is more frequently used than exogen; but the adjectives *endogenous* and *exogenous* are in constant use. All the trees of cold climates, and the principal part of those in hot latitudes, are exogenous. In many cases they are easily recognized by the wood of each different year forming a distinct zone, so that a section of their wood exhibits a number of concentric circles; but there are so many exceptions to this rule as to render it necessary to consider this character as by no means essential to them.

In an exogen of ordinary structure the embryo consists of a cellular basis, in which there is usually no trace of woody or vascular tissue; but as soon as germination commences, fine ligneous cords, or woody bundles, are seen proceeding from the cotyledons towards the radicles. When the young exogen has arrived at the end of its first year's growth it has a stem with a hollow woody axis surrounding cellular tissue, the whole being covered in by a cellular integument. But as the woody bundles are merely plunged into a cellular basis the latter passes between them in a radiating manner, connecting the centre with the circumference by straight passages, often imperceptible to the naked eye, but always present. The annexed diagram illustrates this.

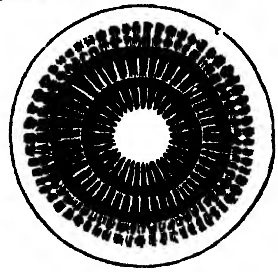
Here we have the origin of *pith* in the central cellular tissue of the stem, of *wood* in the woody axis, of *bark* in the cellular integument, and of *medullary processes* in the radiating passages of cellular tissue connecting the centre with the circumference.

The woody axis is not, however, quite homogeneous at this time. That part which is next the centre contains great numbers of vessels of different kinds, particularly dotted vessels; the part next the circumference is altogether destitute of vessels, and consists of woody tissue exclusively. Of these two parts that with the vessels belongs to the wood, properly so called, and serves as a mould on which future wood is added; the other belongs to the bark, separates under the form of liber, and in like manner serves as a mould upon which future liber is disposed.

At the commencement of the second year's growth the thin-walled cells between the liber and the wood multiply rapidly by division, and, extending in a complete ring, form new wood on the inside next the old wood, and new liber on the outside next the old liber. This tissue is commonly known as the cambium. The stem continues to lengthen, forming new leaves over its surface. The woody bundles in the leaves are prolonged into the stem, passing down into the cambium, and partly joining the wood and partly the liber of the previous year, the former again having vessels intermingled with them, the latter having none. The cambium grows between the wood and liber horizontally while they grow perpendicularly, extending to make room for them, and consequently interposed between the woody cords of which they each consist, forming in fact a new set of medullary processes, terminating on the one hand in those of the first year's wood, and on the other in those of the first year's liber.



Stem of an Exogen one year old.



Stem of an Exogen two years old.

This addition of new matter takes place equally in the stem and in the root, the latter extending and dividing at its points, and receiving the ends of the woody cords as they diverge from the main body. The diagram given above illustrates this, and shows, when compared with the last, what difference there is in the appearance of the stem of an exogen one year old and two years old.

And thus, year after year, the exogen goes on, forming zone upon zone of wood, which is permanent, and zone within zone of liber, which perishes as the stem increases in diameter.

If this formation is compared with that of monocotyledons, it must be obvious that the stem of these two great classes is formed from the very beginning in an essentially different manner. Some anomalous forms may be noticed here. In Piper, Mirabilis, and Boerhaavia, the central part of the stem consists of cellular tissue, among which cords of spiral vessels and woody tissue are placed either without order, or (in Boerhaavia) in a cruciate manner, as in tree-ferns, and that on the outside of this the woody bundles are arranged circularly into a cylinder. This only shows that in certain exogens a portion of the central tissue is placed at first in a confused manner, and that the wood does not assume a definite circular disposition till afterwards. We find in *Piper nigrum* that from the beginning the woody bundles are placed circularly, but they are separated by a good deal of cellular tissue, and do not assume in the first zone the wedge-like or triangular form which is most common in exogens, and which they themselves at last take on.

From what has been stated it will be obvious that the most essential features of exogenous vegetation are, not concentric circles in the wood, but an arrangement of the woody matter in a circular manner round pith, its augmentation by external additions, and the universal presence of medullary processes which give the wood a radiated character.

If exogens or dicotyledons are distinctly known from monocotyledons by their peculiar manner of growth, and by the arrangement of their woody matter, they are not less clearly defined by external marks.

Their *leaves* have the veins ramifying from the midrib, or ribs, if there are several, in so intricate a manner as to give the appearance of irregular network. Their veins never run parallel with each other without ramifications; for if, as sometimes happens, they appear to do so, it will be found that the appearance is confined to the principal veins or ribs, and that the secondary veins between them ramify in the usual way. The leaves are, moreover, in most cases articulated with the stem, leaving behind them a clean scar when they die, not rotting away and hanging upon the stem in the form of a ragged sheath, as is common in monocotyledons; and are frequently furnished with stipules—an unusual circumstance in monocotyledons.

The *flowers* of dicotyledons are usually constructed upon a quinary type, that is, they have five sepals, five petals, and five stamens, or some power of that number; now and then they vary to a type of four, or they exceed the number five; but we very rarely find the ternary structure of monocotyledons present in them. If, as in Anonaceæ, Berberidaceæ, and other orders, the sepals and petals follow a ternary type, the number three is lost in the stamens or the ovary. The order Menispermaceæ is the only one among dicotyledons in which the ternary type regularly pervades all the parts of the flower.

In their manner of growth they rarely resemble monocotyledons. The consequence of the ramification of the veins is to give their leaves a broad and rounded figure, the effect of which upon their general appearance is to produce the rounded lumpish aspect that we recognize in all the trees naturally inhabiting this country. In no known instance does the stem grow by the development of a single terminal bud; so that we never find in this class the columnar aspect of palm-trees, unless the genus Theophrasta be considered an exception.

The differences between dicotyledons and monocotyledons, thus strongly marked in the stem, leaves, and flowers, are connected with others in the *embryo*. In dicotyledons of the common kind this organ has two lobes, held together by a minute central body, the upper end of which, between the lobes, is the plumule or rudimentary stem, the lower the radicle, which afterwards produces the root; the lobes themselves, or cotyledons, are rudimentary leaves. This structure is readily seen in a hazel nut, or a garden bean; the deviations from it are few and unimportant as compared with those of monocotyledons. Three or a greater number of cotyledons may be present in a whorl, instead of two opposite to each other. Or one of the two cotyledons may be much smaller than the other, as in Trapa; or they may be deeply lobed, as in the garden cress. But in all these cases the deviations are obviously reconcilable with the typical character of being *dicotyledonous*.

When the embryo of a dicotyledon germinates, the radicle simply lengthens at its point, without having to break through the coat of the embryo; on this account dicotyledons have been named *exorhizal*.

The result of this examination is, that the great class of exogens or dicotyledons has five important and in some measure independent characters, by which its limits are settled:—

1. The wood is exogenous.
2. The veins of the leaves are netted.
3. The fructification is formed upon a quinary or quaternary type.
4. The embryo is dicotyledonous.
5. The germination is exorhizal.

In consequence of imperfect development, and the abortion or multiplication of its parts, many deviations occur from the above characters. But there is not in consequence any real difficulty in distinguishing exogens from other plants. Suppose the stem to be so slightly formed, as in Podostemaceæ or the aquatic Halorageæ, as not to arrive at a state in which the exogenous arrangement is perceptible, we have the dicotyledonous embryo and the typical number of the floral organs to guide us. Let the leaves appear as scales, as in Lathræa, Orobanche, and the like, still there is the embryo, or again the floral proportions. If the fructification is absolutely ternary, as in Menispermaceæ, the organization of the stem, leaves, and embryo reveals the true nature of such plants. Or if the embryo is undivided, as in Cuscuta, and at the same time the veins of the leaves deficient, and all this with an incomplete formation of woody matter, then the number of parts in the flower remains to prevent our falling into error. It is therefore always to be remembered that the limits of this great class are not exclusively determined by one single character, but by a combination of five, a part of which may be occasionally exceptional or undiscoverable.

Whatever uses there may be in the vegetable kingdom are to be found chiefly in this class, which comprehends four-fifths of the natural orders, and probably not much less than the same proportion of species. Timber in particular is their exclusive produce; and if corn has no direct analogy in exogens, at least a substitute for it is furnished by the potato and the cassava. To speak, therefore, of its useful products would be, in fact, to explain the utility of plants to man.

EX'ORCISM (a word derived from Gr. *exorkizma*, to administer an oath or banish an evil spirit from a man by conjuration) is a term applied to the act of driving an evil spirit out of one possessed by a command in the name of some divine power. The ability to effect this by such means has been accepted as a belief by pagans, Jews, and Christians, and ceremonials with this object are still in use among the Roman Catholics and the closer followers of the teachings of Luther, who continued to keep his opinions in this respect after the Reformation. One of the minor orders of the Roman Catholic clergy exercise the function, and it is only used in cases of supposed demoniacal possession, in the administration of baptism, and in the blessing of the holy oil or *chrism*, and of holy water.

EX'OSMOSE. See Osmosis.

EXOSTEM'MA, a genus of plants belonging to the order Rubiaceæ (tribe Cinchoneæ). The species are trees or shrubs, with lanceolate oval short-stalked leaves, and stipules solitary on each side of the petioles. The flowers are white or pink; the corolla is funnel-shaped with the limb divided into linear segments; the five stamens project some distance beyond the tube of the corolla, whence the name of the genus; the ovary is two-celled with a long style. *Exostemma caribæum* (Quinquina Piton, sea-side beech) is a tree about 20 feet high, and a native of the Caribbee Islands, Guadaloupe, St. Domingo, Jamaica, Cuba, Santa Cruz, and Mexico to Guiana. This plant is the *Cinchona caribæa* of Jacquin. The capsules before they are ripened are very bitter, and produce a burning itching when applied to the nostrils and lips. The bark is also bitter, and possesses a tonic, febrifuge, and emetic action on the system, but it does not appear to have either quinine or cinchonine in its composition. The bark is generally smooth and gray on the outside. *Exostemma floribunda* (Quinquina of St. Lucia) is a native of the West India islands, among woods by the sides of torrents. The bark is similar to the last, and used as a substitute for the Peruvian bark. *Exostemma Souzanum* (Quinquina de Piauhi) is a native of Brazil, and is used as a substitute for the Peruvian bark. *Exostemma Peruvianum* (the *Cinchona Peruviana* of Poiret) is a tree 10 or 12 feet high, and grows in the colder parts of Peru, on the declivities of the Andes, between the river Chota and the village of Querocotillo, 3000 feet above the level of the sea. The bark is very bitter, and has a sweetish taste with a nauseous smell. There are several other species of Exostemma, which have also been used as cinchona barks, but the above are those which are best known.

EXOSTO'SIS, a swelling or tumour of a bone (*osteon*). This term has been applied very generally to all tumours of the bones, whether they partake of the characters of osseous structures or not. True exostosis is an hypertrophy of the tissues which constitute the bone. Hypertrophy of a bone may arise from natural causes, and is produced by anything which constantly increases the action of a part.

The more frequent cause of an exostosis which requires treatment, is the production of increased action of the part by the application of some stimulus. It is difficult frequently in bones to trace the increased action to the true cause. It sometimes, however, follows a blow; and some persons are so predisposed to take on this form of action, that slight injuries are followed by exostoses. The structure and density of exostoses vary much. Sometimes they exhibit a light cellular structure, like the cancellated structure of bones, and are frequently much lighter and more cancellar than is ever observed in this structure in its normal development. At other times the structure of the exostoses is much harder than common bone, and possesses all the characters of ivory. The cancellated structures sometimes attain a considerable size, but the ivory exostoses seldom exceed the size of a bean. The first are most common on the long bones, as the femur, tibia, humerus; the last on the cranium and bones of the face. Sometimes the increased action of the tissue extends to the whole bone, and every part is enlarged. No kind of external treatment is beneficial in any of the forms of exostosis; and when, on account of their position, it is thought right to treat them, they must be removed by sawing or cutting away.

EX'OTERIC and **ES'OTERIC** (Gr. *exoterikos* and *esoterikos*, literally external and internal) were two terms used in reference to the writings and doctrines of many of the ancient Greek philosophers. The exoteric were those writings and doctrines which were in a more popular form, the esoteric those which were fitted only for the learned or the initiated.

EXOT'IC PLANTS, or **EXOT'ICS**, are plants brought from foreign countries, and cultivated in this country. The largest and most tender exotics are reared in greenhouses.

EXPAN'SION. One result of heat is, in the large majority of cases, to produce an increase of size in the heated body. Ice is the great exception to the rule, for ice, as distressed householders find by the bursting of their water-pipes in winter frosts, occupies more room than the water from which it was formed by the abstraction of heat. Ice when warmed shrinks into water. Bismuth follows the rule of ice. Garnets also shrink with heat, and iodide of potassium behaves in the same manner. But heat nearly always increases the size of bodies, and in every case it gives their molecules greater mobility. The molecules of solids lose part of that cohesion which enables them to retain the shape of the body, and fly apart into a mobile liquid form; the molecules of liquids if heated lose cohesion altogether, and assume an attitude of mutual repulsion in the highly elastic form of a gas. Speaking roughly, in a solid the molecules are at their nearest, in a liquid they are less near, in a gas they seek to fly apart. Yet this last must be within limits, for the atmosphere, though gaseous, is yet retained to the earth, and does not fly off into space.

The expansion of solids is readily shown by heating a bar and observing its increase in linear extension, in thickness, and in cubic capacity. It is found that a brass rod at the freezing point (32° Fahr.) measuring 1 inch will measure 1·001867 at the boiling point (212° Fahr.), giving the average coefficient of linear expansion for brass at 1-180th part of this therefore, namely, ·00001038 for each degree Fahr. of rise in temperature. The superficial expansion is equal to twice the linear, and the cubical expansion to three times the linear; the coefficients of expansion increase with increase of temperature. That is to say, an increase of temperature produces greater expansion in a hot body than in a cool one. Small as the linear expansion of metals seems it yet presents problems of considerable magnitude. Take the case of the iron rails on a railway, say between London and Edinburgh (400 miles), and assume the total variation in temperature between winter cold and summer heat to be only 50° Fahr. Then, since we know that 1 yard of iron at 32° Fahr. will, if raised through 180° to boiling heat (212° Fahr.), measure 1·001235 yards, we may assume roughly that the annual variation in length due to temperature is as 70 to 180 upon this amount. But on making the calculation it appears that the increase in length from January to July is no less than 338 yards on this distance. It is found necessary therefore to separate the rails by a slight interval, as probably all readers have already observed; were it otherwise the rails when warmed would press hard end to end, and bending in the middle by their expansive energy would tear up their bed.

The expansion of liquids is only measurable in a cubical sense. It is made use of in the familiar thermometer to measure heat readily. Yet here we must observe that we see not the expansion of the mercury or the spirit, but its excess over the expansion of the tube. The glass tube expands between freezing and boiling point as 1 to 1·00083333, and of course if it expanded exactly as much as the mercury we should see the latter remain at the same point in the tube. Seeing, however, that mercury expands between freezing and boiling points as 1 to 1·18, the difference is so very great that the expansion of the glass may in ordinary cases be disregarded. Liquids expand much more for equal increments of heat than solids, as might be expected from the less cohesive force the heat has to overcome. Between freezing and boiling points water expands one-twenty-third of its volume and alcohol one-eighth.

The average expansion of gases is 1-490th per degree Fahr. Thus, if we have a certain volume of gas at freezing point (32° Fahr.), and raise it to 522° Fahr., that is, through 490°, its volume will be doubled if it is kept under a pressure which remains the same throughout.

EXPEC'TORANTS are medicinal agents which, in certain conditions of the system, will, either by promoting or repressing the secretion of the air-passages and of the lungs, facilitate its expulsion. The articles which bear this name differ considerably as to the means by which this end is accomplished. They are chiefly derived from the vegetable kingdom, some being gum-resins or balsams, of a stimulating quality, while others are possessed of nauseating or sedative properties; vapours also are expectorants, and may be either simple or medicated. Vapours alone reach the organs to be affected, and are therefore the only direct expectorants; and others, being taken into the stomach, must operate by sympathy.

From the difference in the nature of the substances regarded as expectorants, it is clear that they must operate in a very different manner, according to the state of the system, the pathological condition of the lungs, and the stage of the complaint. Great care is necessary in selecting the particular agent suited to each case; and in no set of diseases are greater errors committed by unprofessional persons by an injudicious employment of these agents than in those of the lungs, from common colds to the more serious and fatal affections of these vital organs. The slight nature of many of the common maladies of the throat and lungs, and the fatality of consumption, have led to a degree of interference with the treatment of diseases of these organs not attempted in any other cases, as the multitude of popular remedies for coughs, colds, and consumptions attest.

To treat satisfactorily the diseases of the lungs, it is necessary to know their structure and the relations they have to the other parts of the body. The bronchiæ (or air-passages) and air-cells of the lungs are lined by a

mucous membrane, and have in consequence relations of sympathy with the skin and intestinal canal more close than with any other part of the system. A vicarious discharge or secretion is thrown off by the internal (pneumogastric) or external surface (the skin), and any considerable diminution of this discharge on the part of either is in some degree compensated for by augmented secretion of the other. Hence, when the insensible perspiration of the skin is suddenly checked by exposure to cold, a double duty is thrown upon the internal membrane, sometimes of the intestines, when diarrhœa may result, sometimes of the lungs, when catarrh (common cold) or pneumonia may ensue. This fact enables us both to comprehend the cause of some of the diseases in which expectorants are proper, and their mode of aiding the cure.

Where there is decided inflammation, the best expectorants are those which lessen the inflammatory state, such as venesection and nauseating doses of tartrate of antimony or of ipecacuanha, and the inhalation of the vapour of warm water, simple or medicated, by means of Mudge's Inhaler. But as the use of any such instrument requires considerable exertion of the respiratory organs, where the inflammation is violent it is inadmissible, as the lungs must be kept in as tranquil a state as possible; but the head may be held over a basin of warm water, the vapour of which will be received by the lungs in the ordinary course of respiration.

When the inflammation has subsided, the more stimulating expectorants may be used. Where there is first spasm hindering secretion, and ultimately an excessive exhalation which must be cleared away, a combination of a sedative or antispasmodic medicine with the expectorant is best.

These are the principles which should regulate our choice in the more acute affections of the chest; but as no set of organs are so subject to chronic disorders as the lungs and their appendages, we frequently have recourse to expectorants to alleviate many of the symptoms attendant on them.

Lessening the tendency of blood towards the lungs, and directing it more towards the skin, is of service both in acute and chronic affections of the chest. Hence bathing the feet in warm water on the first feeling of an attack of cold, followed by antimonials or other diaphoretics, is of much utility, if the patient go into a warm bed immediately; while, on the same principle, the use of flannel next the skin is the best preventive, and is indispensable for all delicate persons, particularly if predisposed to diseases of the lungs.

EXPER'IMENTS are acts or operations intended to develop some unknown fact, principle, or effect; or to establish or demonstrate it when discovered. Similar operations, performed merely for amusement, are also often, though incorrectly, called by this name. In rational experiments these two objects are combined. To experimental research is due the present high state of advancement and usefulness of the various sciences most intimately connected with our happiness and well-being. The danger of taking things for granted has been thus pleasantly and instructively pointed out by Archbishop Whately:—"It was objected to the system of Copernicus, when first brought forward, that if the earth turned on its axis, as he represented, a stone dropped from the summit of a tower would not fall at the foot of it, but at a great distance to the west, in the same manner as a stone dropped from the masthead of a ship in full sail does not fall at the foot of the mast, but towards the stern. To this it was answered, that a stone being part of the earth obeys the same laws and moves with it; whereas it is no part of the ship, of which, consequently, its motion is independent. The solution was admitted by some, but opposed by others, and the controversy went on with spirit; nor was it till 100 years after the death of Copernicus that, the experiment being tried, it was ascertained that the stone thus dropped from the head of the mast *does* fall at the foot of it."

EXPLO'SION is the sudden expansion or formation of gaseous matter in a confined space. Its escape is generally accompanied by a loud report. The bursting of a bladder under the air-pump, the bursting of a steam-boiler, and the firing of gunpowder are examples. The explosions which, in the atmosphere, accompany a flash of lightning are ascribed to the rush of air into the vacua produced when the aqueous vapours in large portions of space become rapidly condensed.

EXPLO'SIVES and **EXPLOSIVES ACTS.** Explosives are those chemical compounds or mixtures by means of which explosions may be brought about. The essential condition for an explosive substance is that it should be a liquid or solid capable of being conveniently handled in a small space, and of being, under certain given circumstances, suddenly converted into an immense body of intensely heated and expanded gaseous matter. The pressure which a gas exerts on the space in which it is confined is directly in proportion to its volume; the force of an explosion therefore depends on the volume of gas liberated, other conditions being the same. If twice the volume of gas be produced in the same time, the explosion will be twice as violent; if only half the volume of gas be produced, the force of the explosion will be only half. Since gases expand very considerably when heated to a high temperature, the heat developed by the explosion causes the gas produced to occupy a much greater volume than it would do at ordinary temperatures, and this very materially increases the force of the explosion. Explosive compounds are generally divided into two classes, namely, those mixtures obtained by combining nitrate or chlorate of potash with different combustibles, and those chemical compounds obtained by the action of nitric acid upon substances of organic origin, called nitro-compounds. When nitrate of potash or chlorate of potash is intimately incorporated with such substances as sugar, starch, flour, &c., a species of gunpowder is produced. Some of the substances named, in a minute state of subdivision, suspended in the atmosphere, form an explosive element if they come into contact with an open flame. Such substances, however, it will readily be understood, are not in the mass explosive. They may be subjected to any amount of friction or concussion, or a lighted match may be applied to them, without any result whatever. When mixed, however, with either of the potash salts mentioned, and particularly the chlorate, a compound is obtained violently explosive under friction, concussion, and heat. Such compounds have frequently been named white gunpowder, German gunpowder, &c. Gun-cotton, technically known as pyroxylin, was the first of the nitro-compound class to come into general employment. It is prepared by immersing cotton in a mixture of weak nitric and sulphuric acids, if a soluble cotton is desired; or of strong nitric and sulphuric acids, if an explosive cotton is wanted. The cotton is afterwards washed thoroughly in water. The former preparation, dissolved in ether and alcohol, is largely employed in surgery and photography; the latter is extensively used for blasting purposes and for submarine mines and torpedoes. When exploded in a confined space its force is variously estimated to range from two to eight times that of ordinary gunpowder. The cotton is little changed in appearance by the process, and it has this great advantage that it may be stored and even exploded by detonation when saturated with water. Dynamite and nitro-glycerine are the explosives now most generally used. See DYNAMITE and NITRO-GLYCERINE.

Blasting gelatine, the latest invented explosive, is now much used in foreign countries for blasting purposes. It is a combination of gun-cotton and nitro-glycerine, in the proportion of seven parts of the first to ninety-three of the second, and it is unaffected by water. The property of this class of explosives which renders them so valuable for blasting purposes is that, owing to the rapidity of their

combustion, the escaping gases have no time to seek a vent by a line of least resistance, and thus they act with equal disruptive force in all directions. Gunpowder, on the contrary, needs careful "damping" and securing in the rock before it will exercise its force in the direction required. It is on account of this that the latter still retains its position in gunnery, as explosives such as dynamite are liable to burst the breech of a gun. [See GUNPOWDER.] The forces existing in dynamite, nitro-glycerine, and blasting gelatine, when exploded under similar circumstances, have been estimated in foot-tons with the following results:—

A ton of dynamite	equals	45,675	foot-tons.
" nitro-glycerine	"	64,452	"
" blasting gelatine	"	71,050	"

The Explosives Act of 1875 now regulates the sale and storage of all explosives proper, and of all applied forms of the same, such as gunpowder, nitro-glycerine, dynamite, gun-cotton, blasting powder, fulminate of mercury, coloured fires, fog signals, fireworks, fuzes, rockets, percussion caps, detonators, cartridges, and ammunition of all descriptions.

It is now unlawful for anyone to keep any explosive (with a few exceptions), except a small amount for private use and not for sale, elsewhere than in a factory, a magazine, a store, or in "registered premises." For keeping in either of the three first-named ways a license is necessary; in the case of registered premises it is only necessary for the person to register his name and address with the local authority, and to conform to certain provisions contained in the Act and the orders made thereunder. The quantities which may be kept in the different ways are graduated according to the conditions ("fireproof," &c.), under which the explosive is to be kept.

An Order in Council was afterwards issued defining and classifying the explosive substances for the purposes of the Act. This order made no pretence to be exhaustive, the explosives named in each class being merely set down as examples of the class; and yet the number of explosives so named amounts to no fewer than fifty-nine. They are grouped under seven main heads, the first of which, "gunpowder," includes only gunpowder ordinarily so called. The crude gunpowder mixtures are grouped together under the main head of "nitrate mixtures;" and all the fancy gunpowders, as the modern chemical compounds may be designated, are arranged in other groups according to their composition. Thus, "Schultze's gunpowder" and "cotton gunpowder" are placed among the chemical explosives in the third or "nitro-compound" class. This class embraces nearly all the more important modern explosives, such as dynamite, lithofracteur, glyoxiline, gun-cotton, gun-paper, and picric powders. The "nitro-compound" class is separated into two divisions, one of which contains all liquid or semi-liquid explosives, such as nitro-glycerine and dynamite, and which, from the nature of their composition, are liable to the dangers of "exudation;" the other division includes the dry nitro-compounds, such as gun-cotton, Schultze's gunpowder, and cotton gunpowder. This distinction is also observed in the fourth or "chlorate mixture" class, a class consisting of "any explosive which contains a chlorate." The fifth or "fulminate" class contains all explosives which are of specially sensitive character, and some of which, as the iodide of nitrogen, are so desperately sensitive as to possess very little practical value, although interesting as chemical curiosities. It is difficult, for instance, to see the utility of a compound which may be exploded by the mere vibration of a vehicle passing the house where it is kept. Class six, "ammunition," is a very comprehensive one, and includes cartridges, shells, war rockets, percussion caps, detonators, fog signals, fuzes, and the like. The seventh class consists of "fireworks," the manufactured articles being placed in a separate division from "firework composition," under which term are included "coloured fires," the well-known liability of which to spontaneous ignition when made with particular ingredients renders some special treatment necessary.

Another Act was passed in 1883, in consequence of the discovery of extensive attempts by various secret associations to put in practice their threats of using dynamite for the destruction of public and other buildings in London and elsewhere. The chief results of this legislation are to make the act of illegally causing an explosion likely to endanger life and property a felony with liability to penal servitude for life; to render any subject of the queen, conspiring to bring about an explosion, liable to penal servitude for twenty years; to throw the onus of proof on the suspected person, that any "explosive substance" found in his possession is intended for lawful use, failing which he is liable to penal servitude for fourteen years; to place conspirators in the position of principals; to enable an accused person to be examined on oath, and to compel witnesses to give evidence whether it may incriminate themselves or not; and to empower a ship-master to search any package on board his vessel if he has reason to suspect that explosives are concealed. The definition of "explosive substances" given in the Act is very wide, embracing as it does any materials for making any explosive substance; also any apparatus, machine, implement, or materials used or intended to be used, or adapted for causing or aiding in causing any explosion in or with any explosive substance; also any part of any such apparatus, machine, or implement.

EXPO'NENT. In the algebraical expression a^x, x is called the exponent of a. If we were strictly to preserve the most ancient meaning of the term, x would be called the exponent of the whole symbol a^x; but it is usual to call x the exponent of a, and the logarithm of a^x. From the time of Descartes it has been usual to employ exponents in abbreviation, thus $a \times a$ is abbreviated to a^2; $a \times a \times a$ to a^3, &c. but the principle is now indefinitely extended; and thus we get a^0 which means 1, a^1 which is simply a; and going to minus exponents we find a large series such as a^{-2}, a^{-3}, &c., meaning $\frac{1}{a^2}$, $\frac{1}{a^3}$, &c. Fractional exponents are also freely used, $a^{\frac{2}{3}}$ meaning the square of the cube root of a; or speaking generally $a^{\frac{m}{n}}$ is the mth power of the nth root of a. The theory of *logarithms* flows naturally from this algebraical manner of writing exponents, and from the binomial theorem.

EXPONEN'TIAL or LOGARITH'MIC CURVE. This is a peculiar curve, having the remarkable property that its subtangent is the same at every point of the curve. Its rectangular equation is $y = a^x$, and its name arises from x serving as an exponent or logarithm. There is also an exponential spiral, whose tangent always makes the same angle with its radius vector. Its polar equation is $r = ca^{\theta}$.

EXPORTS. See IMPORTS and EXPORTS.

EXPRESSION OF EMOTION, the outward manifestation, by gesture, of thought and feeling, seems at first sight so various among living beings that it is impossible to bring it under any philosophical arrangement. But in 1872 Mr. Darwin, who had long considered the subject, and who had in 1867 drawn up a series of sixteen queries as to the expressive gestures of native races which he sent to residents in many parts of the world, published his remarkable work on "The Expression of the Emotions in Man and Animals," and at once fixed the basis of inquiry and pointed out the root-principles which would mainly account for the large mass of facts elicited. A wide acquaintance with the facts collected by travellers and

naturalists, and many years of observations on the fresh and unconventional modes of expression by gesture adopted by animals and children, as well as a thoughtful consideration of the manifestations of the insane, led Mr. Darwin to postulate three principles as underlying expression. They are as follows:—

I. *The principle of serviceable associated habits*, as when an angry man clenches his fist, though for generations his nation has ceased to follow the sentiment by instant appeal to fisticuffs.

II. *The principle of antithesis*, as when a dog who stiffens every muscle to the contest which he longs for when angry, wags his tail and throws his whole frame into the most flexuous rapidly changing curves as he fawns upon a beloved master. The action is not the least serviceable, and arises from the intense eagerness to show the utter absence of all feelings apart from love and submission.

III. Beyond the actions which are or have been useful, and beyond those arising in antithesis, lies a group of actions due to the *direct action of the nervous system*, the outcome of excess of nerve force; such are the cold sweat and trembling of fear, and the modifications of the secretions of the body.

The great variety of expressive actions will be found to group themselves under these heads. All actions that regularly accompany any given state of the mind are to be regarded as expressive. Such may be movements of the body, as the wagging of a dog's tail, or the shrugging of a man's shoulders, the erection of the hair, the flow of perspiration, the dilatation of the capillaries (causing blushing), and the use of the vocal or other sound-producing instruments. Even insects express anger, terror, jealousy, and love by their stridulations. With man the respiratory organs are of especial importance in expression, not only in a direct manner, as by tones of the voice, but in the indirect method of speech.

The chief modes of expression are now innate or inherited. Mr. Darwin traces some very well-known expressive movements through a long course of descent. One striking example is the oblique eyebrow so characteristic of grief or anxiety. This he derives thus:—When children scream the blood rushes to the head, and to protect the eyes the eyelids close with force; this action remains in the slight contraction of the eyelids common to all anxious persons who have long left off screaming. But beyond the eyelids other muscles contract, especially the muscles at the root of the nose. When the adult controls the muscles by his will, he checks these pyramidals of the nose by wrinkling his forehead, a second well-known mark of grief. At the same time the wrinkling of the forehead draws up the inner ends of the eyebrows in a highly characteristic manner. Usually at the same time the corners of the mouth droop, and this action, so slight in most adults, is seen in infants to be due to that square opening of the mouth peculiar to the "crying baby," and necessary for the pouring forth unchecked of the loudest volume of sound at the infant's command. Originally due to these causes, these actions are now purely instinctive (inherited), and blind persons blush for shame although they are quite unable to have learned the trick from imitating others, and very often are unconscious that they are observed. Yet it is noteworthy that weeping and laughing have to be learned as necessarily as walking; infants are not born able to do either of the three. Some very characteristic expressions are not universal among mankind—kissing, for instance, is comparatively limited, notwithstanding Steele's famous sentence that "Nature was its author, and it began with the first courtship." The Fuegians, New Zealanders, Papuans, Tahitians, Australians, Eskimos, and many Africans know nothing of it. It expresses affection by touching the beloved object, and this these races all agree in doing, though they do not adopt the special mode of kissing. Some rub noses, others pat the arm or breast, others blow upon various parts of the body of the loved one. On the other hand, the chimpanzees of the Zoological Gardens express their utmost affection by touching each other with protruded lips. Sir John Lubbock ("Prehistoric Times," second edition, London, 1869), who points out this curious fact of so many savages being ignorant of kissing, adds the following odd collection of unusual expressions:—"The Tongans and many Polynesians always sit down when speaking to a superior; the inhabitants of Mallicolo testify admiration by hissing like a goose (Captain Cook observed this); at Vatavulu it is respectful to turn one's back upon a superior, especially in addressing him. Tears are a sign of happiness in the Sandwich Islands, and some of the Eskimos pull noses as a token of respect."

It will be convenient to consider, first, the meaning of the expressions of animals, in the familiar instances of the dog and the cat; and then to mention a few of the more prominent emotions, and account for the expressions typical of them.

The dog has at his command his ears, his tail, and his bark. With these he expresses anger most unmistakably; as, when preparing to attack another dog, he erects his ears and strains his eyes directly forwards (to catch every sound that may assist him by Principle I.), his hair bristles that he may look as fierce as possible, and every muscle is in tension, the tail bolt upright and the limbs stilted and rigid, so that the gait is stiff, and a spring can be made at any instant. At the moment of the spring he utters a savage growl, lays down his ears out of the way of his antagonist's teeth, and uncovers his own teeth by drawing up the lip. His attitude of affection has already been given as an excellent example of Principle II. (antithesis), and contradicts the above in every particular.

The cat presents a most striking contrast to the dog in her modes of expression. The similar means at her command are used altogether otherwise than with him. The well-known arched back and erect hair of a cat whom a dog is teasing must not be taken as the creature's expression of anger so much as of angry fright. True cat-anger is shown when one cat is attacking another. Here we see a crouching attitude adopted, the claws of the fore feet slightly protruded ready for striking, the hair is either not erected, or but slightly, the ears lie back and the teeth are exposed. (The crouching attitude favours the concealment dear to the animal, and is also of use in the stroke. Principle I.) At the same time the tail lashes slowly from side to side with a peculiarly savage effect; and this Darwin considers a case of Principle III., being in his view due to the necessary outlet somewhere of the intense nervous excitement of the creature, not exhausted, as in the case of the dog, by tension of the muscles. Now contrast the behaviour of the cat when affectionate, and a striking instance of Principle II. occurs. Though the attitude is of no service to her she slightly arches her back, purposely adopting the exact opposite of the crouching attitude, the lashing tail of anger now stands bolt upright, and the ears are pricked. The rubbing of the head and body against the beloved mistress no doubt arises from the necessity of touching the object of affection which is shown in our own kiss or warm pressure of the hand, or in the lick of the dog's tongue. Finally, the protrusion of the fore feet alternately evidently remains (by Principle I.) from the actions of the kitten when sucking and pushing the mother in this manner. The habit being concomitant with great pleasure remains as a mode of expression, though now no longer of use.

The more varied expressive powers of man are susceptible of a similar explanation, and a brief attempt to provide this may be made. We shall consider affirmation and negation; anger and love; grief, terror, and joy.

Affirmation and Negation are expressed respectively among ourselves by nodding and by shaking the head. The nod often carries with it a smile, the shake nearly always a frown. It seems almost certain that these signs arise from the motion of the infant's head towards its food, and the sideway motion with which food (especially spoon food) is most readily and firmly declined. A backward movement would not be so efficacious, but such an expression is quite conceivable as a clear negation. This, then, is a case of Principle I. So innate are these signs with our own race from long inheritance that blind persons and deaf mutes use them untaught. Even the celebrated Laura Bridgman, deaf and blind from birth, nods and shakes her head to express approval and dissent. But it is not universally so with other than Aryan people. Guinea negroes, Chinese, and Kafirs, follow our rule, but Australians (aborigines) do so only occasionally. More usually the negative in Gipps' Land is shown by putting out the tongue and leaning the head backwards, a combination of the expression of nausea with the action previously mentioned. The Torres Straits natives use another negative; they "hold up the right hand" (says Mr. J. Beete Jukes, in his "Letters," &c., Lond., 1873), and shake it by turning it half round and back again two or three times. Turks (and Hindus occasionally) throw the head back with a cluck of the tongue for "no," and move the head sideways to the left for "yes." The cluck remains at present unaccounted for. The Eskimos use a nod for yes, and a wink for no. The New Zealanders raise the head for an affirmation, and the Fuegians exactly reverse our own rule, nodding for "no," shaking for "yes," while the North American Indians use varied gestures of the hands and not of the head as their modes of expression. The Dyaks of Borneo raise the eyebrows for "yes," and contract them for "no," the latter no doubt akin to the Eskimos' wink, and to our own frown which accompanies the shake of the head. When bending the head in submissive acquiescence the eyebrows would be raised if the companion is looked at, and this probably explains the origin of the New Zealand and of the Dyak affirmation.

Anger and Love.—In anger the circulation is largely affected, the heart beats quickly, and the skin is suffused with the rapidly driven blood, while the chest heaves with laboured breathing. This no doubt is a case of Principle III., for brain and muscle must be roused to their highest vitality for the contest; and when physical contest is not anticipated, by Principle I. the habit remains. The fist is clenched, even when one is alone and highly vexed, and children indulge in most frantic gestures if angry, stamping and rolling on the ground to give vent to the flow of nervous energy. The frown of anger probably arises from the intense gaze we noticed also in the angry dog, and the lips are withdrawn in a "grin of hate," unquestionably a survival of another animal trait, for men seldom bite, even in actual fighting. This last expression when used alone, and especially if limited to one side, is the well-known characteristic sneer of defiance and contempt. Frequently the hair bristles, also an animal trait.

Love—not the passion, for that is mixed with agitation and fear, but the love of a mother for her infant, for example—is remarkable for the absence of expression, as we might expect from the antithesis to the gestures of anger and hate; the blood flows freely, the breath is calm, the features relax in a gentle smile, and until the infant is threatened with any injury few would suspect that such slight marks of expression indicate the strongest emotion known to man.

Grief, Terror, and Joy.—Weeping, so highly characteristic of grief, is not known to young infants, who do not often shed tears till considerably over 100 days old, but they scream from the moment of birth if in any pain. The firm closure of the eyelids by the surrounding muscles which always accompanies their intense grief is found to be caused by the necessity of protecting the eyeball from being overgorged with blood, and this causes the upper lip to be drawn up. At the same time the angle of the mouth is drawn down till it is almost square, to give room for the loud cry to issue, and the intensity of the scream exhausts the chest, so that the inspiration becomes a forced quick sob. The pressure on the eyeball is believed to be the origin of the tears, which in their physiological aspect have the function of washing away irritating dust, &c., and hence come to be readily secreted in response to any stimulus whatever, though not of a solid nature, such as a bright light, a keen cold wind, &c. (Yawning and great laughter produce tears in exactly the same manner by pressure on the eyes.) Though our eyelids are no longer forcibly closed in grown-up persons, and though we no longer scream, yet weeping and sobbing continue through life (by Principle II.), the modified representatives of the once so vigorous manifestation of grief.

Terror is expressed by wide open eyes and mouth, as if to see and hear every sign from the dreaded quarter, while making as little sound as possible in breathing, and by convulsive beatings of the heart and profuse perspiration, which Darwin most ingeniously attributes to the inherited effects of the headlong flight which originally would undoubtedly be indulged in under terror; though violent exertion is no longer made, and even prostration is frequently experienced, the effects of the long association with such exertion survive. Also these violent symptoms are doubtless partly due to our third principle, the bodily effects of great disturbance of the nervous system, to which unquestionably is to be attributed the well-known effects of terror upon the excrementary secretions of the body and the relaxation of the sphincter muscles. To the paralysis of terror is due also the occasional dropping of the lower jaw, distinct from the wide opening of the mouth referred to above.

Joy exhibits the opposite of the paralysis of terror or the depression of grief; but it is in most parts of its expression far too positive to be an example of pure antithesis. Great joy usually carries with it laughter; children sing and dance when they are glad, the whole frame sparkles with vitality, the eye flashes with inexplicable brightness; the man lives faster and more completely. Less intense joy is expressed by the same symptoms proportionately reduced; vivacity of gesture replaces vivacity of movement, and the silent smile takes the place of the loud laugh. At the same time the principle of antithesis is not without its weight. Sir Charles Bell, in his "Anatomy of Expression," acutely remarks. "In all the exhilarating emotions the eyebrows, eyelids, nostrils, and angles of the mouth are raised: in the depressing passions it is the reverse."

In addition to the great work named, by Darwin, and that by Sir Charles Bell, the subject is treated in a highly interesting manner in Lavater's "Physionomie" (posthumous edition, Paris, 1820), in Herbert Spencer's "Principles of Psychology" (second edition, London, 1872), in Professor Bain's "Emotions and Will" (second edition, Lond., 1866), and in Dr. Duchenne's "Mécanisme de la Physionomie Humaine" (Paris, 1862). In the latter the aid of galvanism is most ingeniously brought to bear upon living subjects, so that the emotional expressions are reproduced by artificial stimulus to the single muscles, and then photographed.

EXTENSION is the greater of the two fundamental properties of matter, the other being RESISTANCE. Possibly we might include colour, but not nearly with the same universality as the other two properties. What distinguishes an object from a thought is its extension and its resistance; then, and if we analyse these two, we shall find that while resistance is obviously seen to be discoverable by the sensation of touch, its companion, though less

obviously, yet no less certainly, depends ultimately upon muscular perceptions. These are shown in the article MUSCLE to consist of the feeling, first, of dead strain, as of a weight in the hand, secondly of movement; and each of these is perceivable in varying degrees, and as lasting during varying periods, and the second as varying in speed.

It is especially the discrimination in amount of the motion of our muscles which enables us to perceive the property of extension. We feel the sweep of the hand as it passes over the surface of an object, or the still subtler sweep of the eye, and our recognition that the external world is an extended world entirely rests ultimately upon these muscular discriminations. Measures of length are the result of one set of perceptions, measures of surface involve another group of perceptions, and still another and far more complex group is required for the conception of a solid body. We gain this experience in various ways. The infant carried in its nurse's arms, or the pedestrian walking many miles towards a mountain, gain their experience by locomotion, comparing their sensations with the judgment of the eyes; older children desire to handle everything, will "cry for the moon" in their eagerness to measure by touch their estimate of size; finally the minute sensations of movement of the eyeballs, of strain on the focussing muscle, and above all of convergence of the eyeballs, serve the grown man accurately and sufficiently for nearly all the purposes of life in the perception of extension. Size, distance, situation, direction, and form are the chief subdivisions of extension. These things we find on examination to be the common experience of all. Two men walking along a street see the same succession of objects; moreover if the walk is reversed the objects recur in reversed order. But the thoughts of the two meanwhile may be as wide as the poles asunder, and on trying to reverse the train of thought it is but too common an experience, as we all find, to be quite unable to recall what was vividly present a few minutes before. This is what makes extension so important a factor in distinguishing between "object" and "subject," or between the external and the internal world of sensations.

EXTORTION, in regard to public officers, consists in the wresting or unlawfully taking by any officer, by colour of his office, any money or valuable thing of or from any man either that is not due, or more than is due, or before it is due. It is an offence at common law, punishable by fine and imprisonment at the discretion of the court, and sometimes also by the forfeiture of the office. There are various statutes providing penalties for extortion by sheriffs, under-sheriffs, bailiffs, jailers, &c. Any person who attempts to extort money, goods, or the appointment to any office by the threat to publish a libel or by the publication of a libel, becomes liable to imprisonment with or without hard labour for any term not exceeding three years. The extorting of money, &c., by a threat or accusation of a crime is felony, punishable with penal servitude for life, or not less than three years. Money that has been obtained by extortion may be recovered in an action at law.

EXTRACTION (of square and cube roots). See SQUARE and CUBE respectively; also EVOLUTION.

EXTRADITION is the act by which a state surrenders any person who has placed himself under its jurisdiction for trial by and according to the laws of some country against which he is accused of having offended. Extradition treaties thus insure that a malefactor shall be precluded from setting human laws at defiance by the easy process of passing beyond the limits of the country in which his crime was committed. The demand for extradition has always been regarded with great jealousy by independent states, and the terms on which it may be demanded are now frequently laid down in a form of convention treaty. The Extradition Act of 1870 enables her Majesty to make such arrangements with foreign states, and put them in force by Order in Council, with the obligation of communicating them to Parliament within six weeks. So far as comprehensiveness is concerned, the most recent of our extradition treaties leave little room for amendment, including as they do every important offence properly covered by such arrangements. It is, however, always expressly stipulated that a fugitive criminal shall not be surrendered if the offence in respect of which his surrender is demanded is one of a political character. Extradition treaties are in force between the United Kingdom and the following countries:—Austria-Hungary, Belgium, Brazil, Denmark, France, Germany, Hayti, Italy, Luxemburg, Netherlands, Portugal, Salvador, Spain, Sweden and Norway, Switzerland, Tonga, United States.

EXTRAORDINARY RAY is the part of a ray of light split into two by a double refracting crystal, which deviates from the ordinary path of a refracted ray in transparent media, and forms a greater angle than usual with the axis. See POLARIZATION.

EXTRAVAGANT CONSTITUTIONS are the papal constitutions (edicts) added by some few popes after the body of the canonical law had been completed. Being "wanderers outside" the Corpus Juris Canonici they have received the title "Extravagant." They are due chiefly to John XXII. and one or two of the other Avignon popes. See CANON LAW.

EXTREME and **MEAN RATIO.** To cut a line according to extreme and mean ratio is a phrase of Euclid which it is not very easy to explain from the words of it. The meaning is, to cut a straight line in such a manner that the whole shall bear to the greater part the same ratio as the greater part to the less; or to make the greater segment a mean proportional between the whole and the less. Accordingly the square of the greater segment must be equal to the rectangle under the whole and the less segment; and Euclid shows how to make this section in the eleventh proposition of the second book.

EXTREME UNCTION, a sacrament of the Roman Catholic Church administered to persons in danger of death, and held by that church to have the effect of remitting sin, infusing grace, strengthening against temptation, and also (although not infallibly) of alleviating and even dispelling the pains of bodily disease (James v. 14, 15). It is administered by a priest, who, dipping his thumb in the holy oil, anoints the sick person, in the form of the cross, upon the eyes, ears, nose, mouth, hands, and feet, at each anointing making use of this form of prayer: "Through this holy unction, and His most tender mercy, may the Lord pardon thee whatever sins thou hast committed by thy sight. Amen." And so of the hearing and the rest, adapting the form to the several senses. The oil used is blessed for the purpose by the bishop every year on Maundy-Thursday, and is reserved for use during the year.

Extreme unction is employed by the Greek Church, but the oil is obtained from the lamps in use in the churches, which is blessed by seven priests when that number can be gathered, or failing this by not less than three.

EYA'LET, the name of the chief administrative division of the Turkish Empire, formerly called a pashalic. The whole empire is divided into eyalets, which are subdivided into livas, or sanjiacks. Each eyalet is under the government of a pasha of two tails.

EYCK, HUBERT VAN. This celebrated old Flemish painter, the elder brother and master of John Van Eyck, was born, according to Van Mander, in 1366, and probably at Eyck (now Alden Eyck), a small village near Maaseyck on the Maas. The two brothers established themselves, first in Bruges, and afterwards in Ghent. The name of Hubert Van Eyck is nearly lost in that of his younger brother and pupil John, apparently from no other reason than that John alone is mentioned by Vasari in his story of the invention of the new method of oil painting, while he takes no

notice whatever of Hubert. Until the time of Hubert Van Eyck oil colours were practically useless for any but minor purposes, as in order to quicken the slow drying of the colours a varnish or medium of oil and resin was employed which fatally injured their brightness. Hubert by using a colourless varnish obviated this difficulty, and by judicious underpainting attained an admirable balance in his tones and shadows, not escaping, however, great artist though he was, much of the stiffness of design and hardness of outline characterizing early Teutonic work. His pupil and younger brother John carried Hubert's art to wonderful perfection. The masterpiece in the National Gallery, a portrait of John Arnolfini and his wife, one of the finest pieces of art of the fifteenth century, is credited to John Van Eyck alone; on the other hand the great work of St. Bavon is in greater part due to Hubert. It is natural to attribute the harder parts to the elder brother, but their work is almost identical.

EYCK, JOHN VAN, was born at or near Maaseyck, as is generally said, in 1390, and died 1440. There are, however, some reasons for supposing him to have been born later. Van Mander says that the brothers Eyck must have painted in their new method as early as 1410; and as Hubert did not die till 18th September, 1426, according to the inscription on his tomb in the church of St. Bavon at Ghent, they worked a sufficient number of years together to completely develop it in practice. John Van Eyck was still young when his brother died, according to Marcus Van Vaernewyck, who published a "History of Belgium" in 1565. John was about twenty-five years younger than his brother Hubert. Supposing John to have been born in 1390, he can have been at first but little more than the assistant of Hubert in their masterpiece, the "Adoration of the Lamb," the great altar-piece of St. Bavon's, Ghent, which was finished by John in 1432. His name is clearly subordinate to Hubert's in the inscription on the work, which is as follows, the last verse being a chronogram:—

> "Pictor Hubertus e Eyck, major quo nemo repertus,
> Incepit; pondusque Johannes arte secundus
> Frater perfecit; Judoci Vyd prece fretus
> VersV seXta MaI Vos CoLLoCat aCta tVerI."

The capitals in the last line, when added together according to their value as Roman numerals, make 1432. The altar-piece is about 14 feet wide by 12 high, and is in two horizontal divisions, each centre covered by revolving wings or doors, two on each side. There are twelve pictures in all, containing about sixty figures and 300 heads. An elaborate copy of it was made by Coxie for Philip II. of Spain. The colouring of the whole work is beautiful, and many parts are admirably executed, while the painting is still in good preservation, owing to the excellent method discovered by the Van Eycks. The fate of the original is remarkable, and much to be regretted. It remained entire till the French took possession of Belgium. The clergy of the cathedral of St. Bavon succeeded in concealing eight of the twelve panels, so that only four were taken to Paris, whence they were brought back in 1815.

EYE, the organ of vision. The peculiarities of structure in the eyes of every animal which has the power of seeing have a close relation to its habits and mode of existence. The eye may be simple or compound, single or multiplied, fixed or movable; it may be deeply imbedded in a bony socket, or may project from the head at the extremity of a sensitive and retractile horn. Yet in all the varieties of configuration the essential parts are similar and are constructed on the same general principles.

The object, or what may be called the general problem, of the beautiful mechanism of the human eye, is to combine distinctness and extent of vision with the security and maintenance of the organ, and the utmost convenience in using it. The parts associated for these purposes are the orbits or sockets of the eye; the optic nerve; the eyeball or globe, with its contents, and the external muscles which move and suspend it; the eyelids; the lachrymal apparatus; the nerves and vessels which supply these parts, and the mass of fatty and cellular substance which isolates and supports them. We shall describe these parts nearly in the order in which they have been enumerated.

The eyes with their appendages are lodged in two symmetrical roomy cavities or orbits in the skull, completed in front by the eyelids, but elsewhere entirely circumscribed by bone, the office of which, it need hardly be said, is to protect them from injury, and from any pressure that might embarrass the perfect freedom and precision of their movements. These cavities are called the *orbits*, *orbital fossæ*, or *sockets* of the eye. Seven bones of the cranium or face enter into the composition of each. Numerous openings and holes exist in these cavities for the transmission of the nerves and bloodvessels, which supply the eye itself as well as its muscular apparatus.

The optic nerves, arising at the back part of the brain, pass horizontally forward above the floor of the cranium, converging towards each other till they meet, when they become closely united. Beyond the point of junction the nerves again diverge from each other, and passing into the optic foramen become invested in a tough, flexible, and fibrous sheath, which is a tubular production of the strong membrane called the dura mater, which lines the cavity of the skull. The nerves, continuing to diverge, reach the eyeball after a somewhat tortuous course of an inch in length. Their length is such as to allow the eyeball to project slightly beyond the edge of the socket in front, and to afford space behind for the action of the muscles which move it, and a suitable distance between their points of attachment. The optic nerve does not consist, like other nerves, of a bundle of distinct fibres, but of a medullary pulp inclosed in minute transparent tubes. The sheath is pierced half an inch from the globe by a vessel called the arteria centralis retinæ, which, accompanied by several small veins, reaches the axis of the nerve and passes with it into the interior of the eye. The nerve does not enter the back of the globe exactly in the axis of vision, but about the fifth part of an inch from it, in a horizontal line, on the inner or nasal side, and subtending an angle of about 23° at the centre of the eye. At this point the dimensions of the sheath are suddenly contracted, and it terminates in a thin cul-de-sac, pierced with minute holes or pores, hence called the *lamina cribrosa* (sieve-like plate). Through these pores the pulp of the nerve, divested of its tubular involucra, passes into the interior of the globe in divided portions, but, immediately reuniting, expands at the back of the eye into a delicate cup-shaped membrane, with the concavity directed forwards. This expansion of the optic nerve is called the *retina;* it is the most important part of the eye, having a peculiar and exclusive sensibility to the impressions of light, of which immediate notice is conveyed from it along the nerve to the brain.

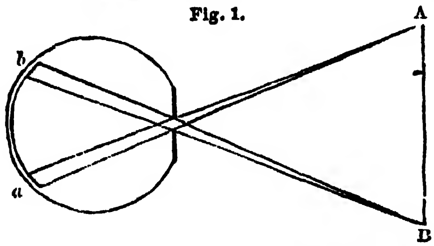
The most elementary fact that we know respecting light is, that it proceeds in straight lines or rays from every point of a luminous or illuminated body. A sensitive surface or retina presented nakedly to such a body would therefore intercept innumerable cones or pencils of light, each diverging from a different point of the object. But each point of the retina must also be considered in that case as the apex of a cone of rays converging upon it from every part of the object; and it is manifest that the various impressions thus received upon the same point at the same time would be undistinguishable from each other. All, therefore, that we can conceive to be communicated to the mind by the sum of such indefinite impressions over the whole retina, is a knowledge of the prevailing colour of the object, and possibly a general idea of its direction. But if there were more objects than one, or that one had "parts or magnitude," even this inconsiderable addition to

the mere sense of light and colour would be impossible. The confusion resulting from the simultaneous impressions of a multitude of pencils of light on the same surface would be partly removed if the seat of perception were placed at the bottom of a cavity capable of being turned to each object or each part of the same object in succession, inasmuch as this would prevent the interference of rays proceeding from parts not actually under contemplation; but an indistinctness would still remain in proportion to the magnitude of the field of view, only remediable by narrowing the cavity to a mere capillary tube, upon the inconvenience of which we need not enlarge.

Let us consider what would be the effect of a very simple addition to the cavity. We will suppose it to be closed in front by a dark screen, perforated with a small central hole, as in the section represented in fig. 1.

In this case pencils of rays crossing each other from A and B, the top and bottom of an object, would impinge at *a* and *b* upon different parts of the retina. By this means the advantages of a large and a small field of view would be combined, a distributed impression of the object would be produced, and its several parts would be seen separately and in their proper relative situations. The effect may be easily shown by holding a card, pierced with a smooth circular

Fig. 1.



hole, near a taper, and throwing the spectrum upon a wall at a little distance. Such a screen is termed the iris.

But still the rays from each point of the object would be diffused over a space, instead of being collected upon a separate point of the surface, and the impressions of contiguous pencils would in some degree overlap and confuse each other. This inconvenience might be lessened by contracting the opening, but another cause of indistinctness would then be introduced in the diminished admission of light.

Both evils might be avoided if a lens of a proper construction were fixed behind the screen, as at *a*, in fig. 2. Pencils diverging from single points of the object would thus be admitted through the opening, which we will call the pupil, and would be made to converge to single points on the surface, and the impression would now be an exact counterpart of the object, A being distinctly seen in its true place and direction from *a*, and B from *b*.

But additional provisions would be necessary to bring this arrangement to the requisite degree of perfection. In the first place, the retina must be adjusted to correspond in shape with the focal distance of the lens. This purpose might be accomplished, if the walls of the cavity were composed of flexible materials, by interposing a transparent fluid between the lens and the retina, which by its uniform distension would constrain the latter to take and retain the form of a portion of a sphere.

Again, if oblique as well as direct pencils are to be brought to a focus, that the lateral vision may be also distinct, a second refracting body of a proper form must be placed in front of the lens. This may be done very conveniently, with the further advantage of completing the cavity, by adding a transparent portion to its walls in front of the screen, to be likewise distended with fluid in order to keep it in the shape of a segment of a sphere. (Fig. 2, *a*.)

It is also desirable that the back of the screen and the interior of the cavity should be blackened, that the rays may be extinguished after impact upon the retina, lest any

Fig. 2.

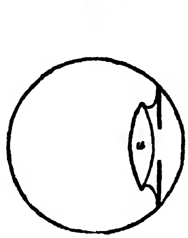


Fig. 3.

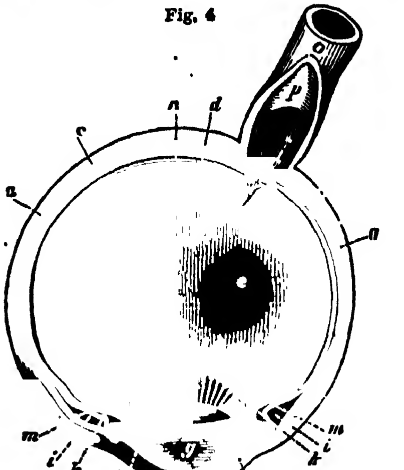
The sclerotic partly removed, and the rest turned back, showing the choroid coat and iris.

internal reflection should interfere with the impressions on other parts. The expediency of this provision is always kept in view in the construction of optical instruments, and may be made evident by looking at a bright object through a polished metal tube. The colouring matter is called the *pigmentum nigrum*, or simply the pigment.

The only remaining artifice is to endow the pupil with the faculty of contraction and enlargement according to the quantity of light. If it were of a constant size, more light would be concentrated upon the retina from a bright or a near object than from one comparatively distant or faintly illuminated; and as the sensibility of the retina must remain the same, the disproportion would occasion dimness of sight in one case and dazzling in the other, and might even impair the nerve.

The figure thus imagined will give some idea of the most important parts and general structure of the eye. We shall now give an account of the principal features in its real anatomical structure.

Fig. 4



Section of the Globe of the Right Eye through the Optic Nerve.

a, sclerotic; *b*, cornea; *c*, choroid; *d*, retina; *e*, vitreous humour; *f*, crystalline humour or lens; *g*, aqueous humour; *h*, iris; *i*, ciliary ligament; *k*, ciliary processes; *l*, ora serrata of the ciliary body; *m*, canal of Petit; *n*, foramen of Soemmering; *o*, sheath of the optic nerve; *p*, substance of the nerve; *q*, arteria centralis retinæ.

The globe or *eyeball* contains the parts immediately concerned in vision. It consists of very unequal portions of two spheres of a different size, which have a common

circular intersection in a transverse vertical plane, much nearer the front than the back of the eye. The iris, or coloured screen, perforated centrally by the pupil, nearly occupies the situation of this imaginary plane, but is, strictly speaking, behind it. The posterior and larger portion is circumscribed by the sclerotic membrane except in front, where it may be considered as bounded by the iris; it is rather less than an inch in diameter, and constitutes about five-sixths of the surface of the globe. The included space is occupied by the choroid coat and retina, the vitreous and crystalline humours, the ciliary body and processes, and a small part of the aqueous humour. The anterior portion, which forms about a quarter of a sphere thirteen-twentieths of an inch in diameter, and occupies the remaining sixth part of the surface of the globe, contains the rest of the aqueous humour, and is bounded in front by the transparent and slightly prominent disc set in the sclerotic like a watch-glass in its metallic rim, and known as the cornea from its horny texture. Its transverse chord, or the diameter of the circle of union between the cornea and sclerotic, is nearly half an inch in length.

The globe derives its firmness to the touch from the distension of the contained fluids; its capability to bear that distension, which insures the permanence of its shape, is due to the flexible but strong and inelastic outer covering or tunic, consisting, as we have said, of the sclerotic and cornea.

The sclerotic membrane is a tough elastic tissue, and appears as an expansion of the external sheath of the optic nerve. To this membrane the muscles which move the eye are attached. It is covered externally by a transparent mucous membrane called the conjunctiva.

The cornea is a kind of transparent continuation of the sclerotic; it has, however, a peculiar structure. It is covered by the conjunctiva, and allows of the passage of the rays of light.

The choroid coat (fig. 3) is a thin, soft, dark-brown structure, in contact with or lining nearly the whole concave surface of the sclerotic. It may be said to originate around the entrance of the optic nerve, which passes through it before it expands into the retina. The choroid consists almost entirely of a multitude of minute vessels, curiously interlaced, and communicating freely with each other. It is supplied with blood by fifteen or twenty branches of the ophthalmic artery, which pierce the sclerotic round the entrance of the nerve.

The pigmentum nigrum appears under the microscope to consist of hexagonal particles arranged side by side, like the cells of a honeycomb. It adheres very loosely, so that, when the surfaces covered with it are drawn to and fro in water, it becomes diffused, and may be washed off. On the inner surface of the choroid the pigment is retained by an extremely fine expansion called Dalrymple's membrane.

The optic nerve, having entered the interior of the globe through the sclerotic and choroid membranes, forms a slight prominence at the point of union of its several portions, and thence spreads out in the form of a fine transparent membrane over the whole concave surface of the choroid, embracing the translucent body called the vitreous humour. This expansion is called the *retina* (fig. 4, *d*). Towards the choroid it appears to consist of a mere homogeneous pulp, not very different from the medullary matter of the brain; but it is undoubtedly most elaborately and minutely organized. Its name may have been derived from the network formed by the branches of the central artery; at least it is not otherwise applicable to the structure of the membrane. The complicated structure of the RETINA is discussed in a separate article. Just where the optic nerve enters the eye there is no power of vision, a fact tested easily by experiment as described in the article BLIND SPOT. *Purkinje's figures* and *visual purple* are described under RETINA.

The vitreous humour (fig. 4, *e*) is a transparent fluid of semi-gelatinous consistence and high refractive power, constituting about five-sixths of the bulk of the globe. It consists of a fluid differing in no great degree from water, contained in a cellulated structure called the hyaloid membrane (Gr. *hualos*, glass), from its perfect translucency. The minute cells are connected together; for if the external part be punctured, the fluid contained in them gradually drains away.

The crystalline lens (fig. 4, *f*) is imbedded in a deep depression in the front of the vitreous humour, a little nearer the nasal than the temporal side of the globe. It has the form and function of a double convex lens. The surfaces may be considered as portions of two unequal spheres, the anterior being considerably flatter than the posterior. The diameter of the sphere of which the former is a segment is about eight-twelfths, of the latter five-twelfths of an inch. The thickness of the lens, measured in the axis of vision, is about the sixth part of an inch, and its transverse diameter is about twice that length. In refractive power it is superior to the other transparent substances contained in the eye. Its consistence is gelatinous, increasing in density from the circumference towards a central nucleus, which has the tenacity of soft wax. It is composed of an infinite succession of thin concentric laminæ, arranged with the utmost regularity, one within another, like the coats of an onion; and every such stratum or elliptic shell is made up of a series of exquisitely minute fibres laid side by side, forming three septa like the cloves of an orange, of which the bounding or cleavage planes diverge from the axis of the lens at angles of 120°. Except in aged persons it is purely white; with age it becomes somewhat yellow. Curious results are produced by this in the case of painters, as all blue colours are slightly altered. Mulready's later pictures do not produce their full effect unless looked at through a yellow glass.

The aqueous humour (fig. 4, *g*) is in no respect distinguishable from water, except in holding a minute portion of several saline ingredients in solution; it occupies the space between the lens and the cornea. The iris divides this space into two unequal portions, called the anterior and posterior chambers of the eye, and so closely approaches the lens, that near the margin of the pupil the two surfaces are separated by a mere film of aqueous humour.

The iris (fig. 4, *h*) arises from the anterior margin of the ciliary ligament, and is extended, as we have seen, across the aqueous humour in the form of a thin partition, with a round aperture or *pupil*, of variable size in the centre, or a little nearer the inner side, the function of which, we need hardly repeat, is to regulate the quantity of light admitted into the eye, by contracting when it is in excess, and dilating when it falls short of the due amount.

The external appearance of the iris is too familiar to need a particular description. It is covered in front with a glistening polished membrane. The brilliancy of the eye depends in a great measure upon the light reflected by this surface, and is lost when its smoothness and transparency are impaired by inflammation. The posterior surface of the iris is called the *uvea*. It is thickly coated with pigment, which is prevented from diffusing itself in the aqueous humour by a membrane like that of Dalrymple on the choroid. Such a provision is particularly needed here on account of the quick movements of the part in a watery fluid. The colouring matter of the iris has much analogy with the pigment. Like that substance it forms no part of the texture it pervades, and when the outer membranes are removed by maceration in water it may be washed away. Both have a relation in quantity, as well as in depth of tint, to the complexion and colour of the hair. In the negro the iris is of so dark a hue that it can scarcely be distinguished from the pupil; while in the white rabbit

and other albinos, including the human variety, where the pigment is entirely wanting from some original malformation, the substance of the iris is transparent, and reflects only the pink colour of the circulating blood. Such eyes are dazzled by a strong light, and probably see better than others in the dusk. The iris, if minutely injected, appears, like the choroid, to be composed almost entirely of vessels, and is also richly supplied with nerves.

The pupil in the human eye is bounded by a sharp, well-defined circular edge. In other animals its shape is subjected to many varieties, which may often be explained by a reference to their habits and circumstances. In fish it is generally crescentic or imperfectly quadrangular. In herbivorous animals, which often continue to browse during the night, it is oblong and obliquely transverse, as in the horse and sheep. In most serpents and many rapacious quadrupeds, both aquatic and terrestrial, the pupil, though round and large at night, is a mere vertical slit when seen by day, especially in the smaller species of each genus, as in the common cat. It is curious that in the larger cats, as the lion and tiger, as well as in some of the larger four-footed reptiles, the pupil again becomes circular. In all birds, we believe, the pupil is round; and it may be observed that, with few exceptions, they all sleep after nightfall. In the few nocturnal species, as the owls, the pupil is very large, though still round, and these birds always shun the day. The long narrow pupil is, in fact, a provision for a greater variation in size than the circular form permits, and is generally found in those animals which roam at night, and also see well by day.

The ciliary body (fig. 4, *l*) rests upon the compressed anterior surface of the vitreous humour where it curves inward from the sclerotic towards the lens, a thin dark annular band, about the fifth part of an inch in breadth, consisting of a frill of flat converging plaits, which encircle but do not reach the circumference of the lens. It is everywhere thickly coated and pervaded with pigment, except at the extremities of about seventy minute unattached points which fringe the inner margin and radiate towards the lens, like the florets of a marigold round its central disc. These are the ciliary processes (fig. 4, *k*). They are separated from the uvea by the fluid of the posterior chamber, and are received behind into corresponding depressions in the vitreous humour. The ciliary body is the focussing muscle of the eye. When it contracts it draws forwards the choroid coat slightly and releases the tension upon the lens, which therefore becomes slightly rounder and adjusts itself to seeing near objects. In its slightly stretched ordinary condition it is adjusted to see distant objects. The range of vision, and the defects known as short sight and long sight, are treated of in the article SIGHT.

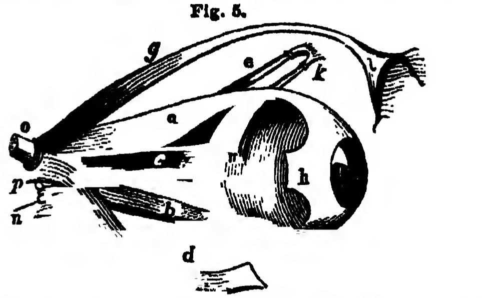
The movements of the globe are effected by six muscles, arising from the bony surface of the orbit, and inserted into different parts of the sclerotic. Four are called recti, that is, straight or direct muscles; the fifth and sixth are the obliqui, superior and inferior, so called from the obliquity of their insertion and their respective positions above and below the globe. The fifth or superior oblique is also called the trochlearis, from the trochlea, or pulley, through which the tendon passes.

The way in which these muscles act may be seen by an inspection of the accompanying diagram, in which, however, the relative size of the parts have been somewhat altered to make them more distinct.

Paralysis of the nerves which supply the muscles, and contraction of the muscles themselves, both produce squinting. This affection is now cured by the operation of dividing the affected muscle.

The textures which enter into the composition of the eyelids (fig. 6) are included between a soft external skin and a moist smooth internal surface, a continuation of the conjunctiva. The eyelids meet, when closed, by two narrow flat surfaces, accurately applied to each other, called their ciliary or tarsal margins. These epithets are respectively derived from the tarsi, or thin concave and crescentic shells of smooth and elastic cartilage, which give form to the lids and firmness and outline to their opposed edges; and from the lashes or cilia, which grow in several rows at the margins of both lids, from their extreme outward verge, and in the direction of the flat surfaces.

Fig. 5.

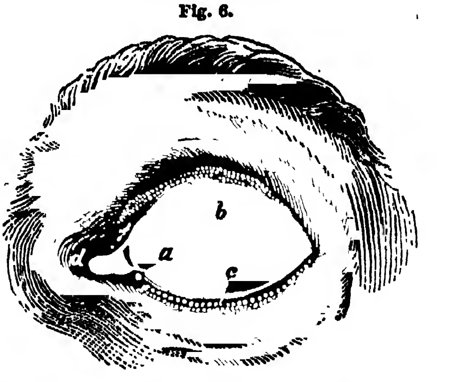


Lateral view of the Eyeball seen from the outer side, with its muscles.

a, rectus superior; *b*, rectus inferior; *c*, rectus internus; *d*, rectus externus, arising by a double head (it is represented as cut off from *h*, its insertion into the eyeball, and turned aside to show the parts behind it); *e*, obliquus superior, a round and tapering muscle terminating in a round tendon, which passes through a pulley or loop, *k*, and is reflected under the flat tendon of the rectus superior, and, becoming flat, is inserted at *m* into the sclerotic; *f*, obliquus inferior coming round over the tendon of the rectus inferior from the front and inner edge of the orbit, near the inner corner of the eye, and inserted into the sclerotic opposite the insertion of the superior oblique; *g*, levator palpebræ superioris, ending in a flat tendon which is inserted into (*l*) the crescentic tarsal cartilage of the upper lid; *o*, *n*, the optic nerve; *p*, the nerves of the third, fifth, and sixth pair, which pass between the two heads of the rectus externus. The rest of their course is not shown.

Immediately beneath the subcutaneous cellular tissue there is a broad layer of musuclar fibres arranged elliptically round the transverse fissure of the eyelids. The office of this muscle, which is called the orbicularis, is to close the lids; and it is capable of acting under certain circumstances with great force. It is collected at the inner angle or canthus of the eye into a round short tendon, which is attached in that situation to the bone. Elsewhere it is connected with the skin and aponeurotic expansions of the face and forehead.

Fig. 6.



View of the left Eyebrow and Eyelids, showing their Tarsal Margins.

a, lower punctum lachrymale; *b*, tarsal edge of the upper lid; *c*, orifices of the ducts of the Meibomian glands (those on the upper lid are similar); *d*, caruncle, situated at the inner canthus, or corner of the eye.

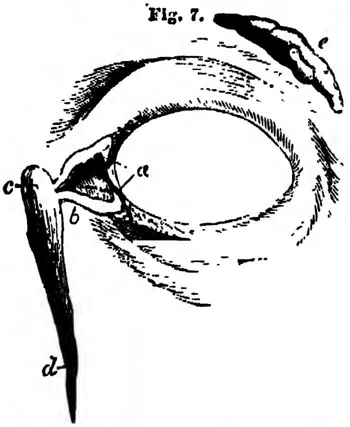
The double line of points external to the Meibomian orifices marks the situation of the eyelashes, which are removed.

Below the orbicularis, in the upper lid, is the broad tendon of the muscle which elevates the upper lid.

Between the tarsus of each eyelid and the conjunctiva are disposed numerous vertical rows of minute whitish grains, which appear through the semi-transparent mucous membrane, and occupy an elliptic space, taking both eyelids together, of about half an inch in width, exactly in front of the globe. These are called the Meibomian glands, from their discoverer. They secrete an unctuous matter which passes into tubes centrally placed in each row, and exudes from as many minute orifices on the ciliary margin of the eyelid (fig. 6, *c*). There are about forty of these parallel clusters in the upper lid; in the lower there are not so many, nor are they individually so long. This secretion often collects in a sensible quantity upon the edges of the eyelids during sleep, especially when the glandular action is excited by slight inflammatory irritation of the part. The palpebral conjunctiva, already described, immediately covers these glandular corpuscles. The caruncle, a small red prominence at the inner angle of the eye (fig. 6, *d*), consists of a number of similar bodies.

At the upper and outer part of the interior of the eyelid are several minute orifices, generally seven in number, arranged in a half-circle, which lead into the secretory ducts of the lachrymal gland (fig. 7, *e*). This is a white

Fig. 7.



a, the two puncta leading into the lachrymal ducts; *b*, the common entrance of these ducts into the lachrymal sac; *c*, the head of the lachrymal sac; *d*, the narrow portion of the sac, or membranous lachrymal canal, passing downwards to the nose; *e*, the lachrymal gland.

flattened lobulated body, of the size of a large bean, lodged in a depression just within the margin of the orbit, and covered externally by the orbicular muscle. The function of this gland is to secrete the tears, and is probably always going on, although not in a degree sufficient to be remarked, except in weeping or when some foreign body or acrid vapour stimulates the surface of the eye, and by sympathy excites the gland to unusual secretion.

The approximation of the eyelids towards the nose in winking is one of the several provisions by which offending particles or superfluous fluids are brought to the inner canthus of the eye, in order to be protruded or absorbed. In this situation there is a vacant space partly occupied by the caruncle, called the lacus lachrymalis (fig. 6, *d*); it is a sort of reservoir, or rather sink, for the tears. Above and below, at the entrance of this space where the ciliary margins terminate, there is a small prominence on the inner edge of both (fig. 6, *a*; 7, *a*), centrally punctured by small orifices. These are the puncta lachrymalia. They are the emunctories of the eye; and their function is to absorb the fluids presented to them, and convey them by two converging canals (fig. 7, *a*) to the lachrymal sac (fig. 7, *c*), which they enter by a common orifice (fig. 7, *b*). This is a membranous bag, about as large as a kidney bean, lodged in a groove in the lachrymal bone, behind the tendon of the orbicular muscle. The lachrymal sac entering a vertical channel in the bone at the end of the groove is narrowed into the lachrymal canal (fig. 7, *d*), and passes directly downwards into the inferior meatus or chamber of the nose, which it enters on the outer side by a slit in the mucous lining. It is not exactly understood in what way the puncta absorb, whether by capillary attraction or by some vital force of suction. The side of the lachrymal sac is connected with the tendon of the orbicularis, which may aid in producing the effect by suddenly drawing its membranous surfaces apart. We all know the effect of repeated winking when the eyes are filled with tears.

The eye is not without defects, though few would say with Helmholtz that an optician who sent home so faulty an instrument would receive a reprimand. ASTIGMATISM has received attention elsewhere, and under SIGHT the several defects of myopia, hypermetropia, and presbyopia are treated. We have already mentioned the yellowing of the crystalline lens by age. It only remains here to add an account of the *aberration of the eye*. This is of two kinds, spherical and chromatic. Spherical aberration is due to the rays passing through the circumference of the lens being, by a well-known optical rule, refracted more than those passing through its central part. The interposition of a "diaphragm" is necessary, and this is the office of the iris in the eye, which corrects spherical aberration to a very considerable extent. Chromatic aberration arises from the breaking up of white light during refraction into its coloured constituents, so that images are surrounded by a coloured fringe, a well-known defect in single lenses. [See ABERRATION.] This is guarded against, in a healthy eye, by the unequally refractive powers of the different media of the cornea—the aqueous, the crystalline, and the vitreous humours. If we disturb the usual conditions of sight, as for instance when the image is not received at its focal distance upon the retina, then, since the colours of the spectrum are unequally refrangible [see SPECTRUM], when we focus for red we are out of focus for violet, &c. As the red rays are least refrangible, in any difficulty the eye usually focusses for them, and in such cases objects have a violet or bluish fringe. A small white object cannot be focussed on the retina, and will be found to cause this chromatic aberration. In consequence of this defect in the eye the resulting fringe increases the apparent size of the object by the effect termed "irradiation." Thus a white square on a black ground always looks larger than a black square of the same size on a white ground.

Comparative Anatomy of the Eye.—The eyes of insects and many other articulated animals often consist of myriads of simple eyes grouped in one compound organ. The eye of the lobster is said to contain at least 5000. Such organs are commonly placed one on each side of the head. The horny, rounded, naked, and transparent part seen externally represents the cornea. Its surface, when viewed by the microscope, displays as many hexagonal facets as the organ contains simple eyes. Beneath each facet is applied the base of a minute transparent cone which constitutes the lens. These cones are arranged side by side with their acute angles directed inwards to the terminations of as many fibres of an optic nerve. A choroid pigment is spread beneath, and often separates the lenticular cones. Vestiges of the aqueous and vitreous humours are also frequently present. When the eyes are simple, as in the spiders, there are generally several, from two to twelve, placed on different parts of the head and thorax. The lens is of the usual spherical shape, hard and sparkling, and highly refractive. In fish and other aquatic animals the lens is dense, hard, and spherical, to make up in refractive power for the density of the medium through which light reaches the eye. On the other hand the cornea is flat, and there is little aqueous humour. Such provisions would be of no value; for, as the refractive power of water

is the same as that of aqueous humour, rays penetrating the surface, however shaped, would pass on in the direction of their entrance. Fish are unprovided with eyelids, and the eyeball has but little independent motion. There is a red gelatinous structure near the optic nerve, between the layers of the choroid, the use of which is unknown. It is called the choroid gland. The ciliary body and processes are generally absent; but there is a rudiment in the eyes of fish of that part called the pecten in birds.

The eyeballs of quadrupeds and other mammalia resemble the human order in structure, and differ from it, but not essentially, in form.

EYE, in horticulture, the name technically given to the bud of a plant. The power of propagating plants by any other means than seeds depends entirely on the presence of leaf-buds, or *eyes*, as they are called by gardeners. A plant may, in fact, be regarded as a congeries of individuals, and each leaf-bud is an individual capable of maintaining an independent existence. Though this is generally true, the buds of all plants will not grow when removed from their parent stock. Many, however, admit of their buds being removed from one branch and placed upon another, which constitutes the process of BUDDING. Others admit of a branch being removed and placed in the ground, when the leaf-buds upon it will develop, and the wood of the branch form roots. Such branches are called CUTTINGS. A few plants admit of single buds being taken and planted in the earth, when they will grow and produce plants in the same manner as seeds. It must, however, be borne in mind in this case that the individual, and not the species, as is the case with seeds, is propagated; the peculiarities of the plant, be they bad or good, will reappear. The plants which are most frequently propagated by eyes are the potato and the vine. For plants to grow in this manner the bud requires that a due supply of nutriment should be stored up in the branch or part of the stem to which it is attached.

In propagating the vine by this means an eye is taken with a small portion of the stem adhering to it, and is placed in earth with a bottom heat of 75° or 80°. This should be done before the sap is put in motion in the spring. It should be kept in a damp atmosphere, when it speedily shoots up into a branch, and at the same time establishes itself in the soil by the development of roots.

EYE, a municipal and at one time a parliamentary borough of England, in Suffolk, 20 miles north of Ipswich and 94 from London by the Great Eastern Railway, situated on a small affluent of the Waveney. As its name (*ea* or *ey*) indicates, it was formerly an island in the marshes, but is now a rather busy town, irregularly built, with a town-hall, corn exchange, and market-place; grammar-school, with two exhibitions to the University of Cambridge; a spacious Perpendicular church; and a well-built and well-conducted "rettory" or flax-dressing establishment, which produces 10 tons of fine flax fibre weekly, and employs 300 hands. There are also several breweries and an iron-foundry. There were formerly a castle and a priory in the town. The municipal borough is governed by four aldermen and twelve councillors. The parliamentary borough included eleven parishes, and had only 988 registered electors in 1881, and was deprived of its member by the Redistribution Act of 1885 It returned two down to the passing of the Reform Act of 1832. The population of the parish is only 2396.

EY'LAU or **EI'LAU,** a town in Prussia, about 22 miles south of Königsberg, is celebrated as the scene of a sanguinary battle between the French and the allied Prussians and Russians on 8th February, 1807. The allies lost 20,000 men, and the French a much larger number. Victory was, however, claimed for the latter.

EY'RA (*Felis eyra*) is one of the small members of the great Cat tribe, FELIDÆ. It is about the size of our domestic cat, but in external appearance greatly resembles a weasel, its long lithe body being supported on very short legs; the neck is long and the head small and round. In colour it is light reddish-brown. The eyra is confined to South America and Mexico. It inhabits thick forests, and preys with all the ferocity of its tribe on birds and small mammals. The eyra is a rare animal, but may be seen in the London Zoological Gardens in company with the lesser cats, such as the lynxes, ocelot, and serval. Attempts at domesticating it have met with success.

EYRE, JUSTICES IN, a corruption for "justices *in itinere*" (on journey). These itinerant justices arose out of the needs of the king's exchequer, the barons of which court when sitting in their fiscal capacity were called *Barones scaccarii*. It was found necessary to tell off certain barons of their number to proceed through the country assessing the due contributions of the lieges. These exchequer barons adjudicated also in pleas concerning the crown, though common pleas were forbidden to be heard in the exchequer as early as 1282; and thus the first popular court of law sprang from what in its origin was a mere assessment body. Henry I. was the first regularly to organize the justices in eyre, though the Conqueror had already taken steps in this direction, following precedents set by the preceding English kings. These latter had themselves periodically visited different parts of the kingdom for judicial purposes. Magna Carta (the eighteenth article) provides for four assizes a year—the merely fiscal duties being now quite subordinate, and the system developing rapidly into a means of bringing justice to the people. In 1217, on the revision of Magna Carta, one yearly assize was deemed sufficient. Here the judges had to determine and assess the feudal exactions of "Darrein presentment,' "Mort d'ancestor," and "Novel disseisin;" or as we should say, inquiries into disputes about the right of patronage to church livings, about the ownership of property by a deceased person the claim of whose heir was disputed, and about the alleged wrongs of a disseised or ejected landowner, turned out of land alleged to be rightly his. In the following reign (Henry III.) the circuits were held only about every seven years. Edward I. remodelled the whole system in 1285 (statute of Westminster), in 1293, and in 1299, finally dividing the country into four circuits, each with two judges, who sat under the five separate commissions following:—

1. *Assize*, to decide disputes as to land of the nature indicated in the charter as aforesaid, and others.

2. *Nisi Prius* (1285), to decide disputed questions of fact—which by statute must be tried at Westminster, "unless before" (*nisi prius*) the day fixed for that trial itinerant judges arrived in the district; in which case they were ordered to adjudicate.

3. *Oyer and Terminer* (1328, 2 Edward III.), to "hear and determine" cases of treason, felony, and misdemeanour.

4. *Gaol Delivery* (1297): all prisoners in the gaol to be brought before the judges.

5. *Commission of the Peace:* all justices of the peace, having no lawful impediment, being bound to attend the judges at the assize, a regulation which soon dropped into desuetude.

EZE'KIEL (meaning "God will strengthen" or "God will prevail") was the son of a priest named Buzi. His birthplace is unknown, but his father appears to have lived at Jerusalem, and to have occupied a position of some importance. The year of the birth of Ezekiel is variously estimated by biblical scholars, but it was probably somewhere about 624 B.C. In the first Babylonian captivity he was carried away by Nebuchadnezzar into Babylonia with the king, Jehoiachim, and all the principal inhabitants of Jerusalem, and he settled with a number of the exiles at a place called Tel-abib, on the banks of the Chebar, a river or canal of the country. From incidental allusions in his book we learn that he was married and had a house of

his own, and that he lost his wife suddenly during the ninth year of his exile (chap. xxiv. 18; viii. i.) Among his compatriots he held a leading position, and was consulted by the elders on all important occasions. He received his call to the office of prophet in the fifth year of the captivity, and continued his ministrations to the twenty-seventh year at least, that is, until the fourteenth year after the destruction of Jerusalem by Nebuchadnezzar. According to an old tradition he was murdered in Babylon by a Jewish prince, whom he had convicted of idolatry, and was buried on the banks of the Euphrates; but this tradition has little or no historical value, and nothing authentic is known concerning the death of the prophet. He appears to have possessed much sternness and energy of character, to have felt a deep attachment to the religion of his forefathers, and to have been ready to exercise any amount of self-denial necessary to carry out his mission. A strong conviction of the dignity and importance of the priestly office is also plainly manifest in his writings.

In the English version the Book of Ezekiel is divided into forty-eight chapters, and these may again be divided into three sections. The first portion, extending from the commencement of the book to the end of the twenty-fourth chapter, contains a series of visions and oracles, directed by the prophet to his countrymen in connection with their relations to Babylon. Then follow eight chapters containing prophecies relating to seven foreign nations, viz. Ammon, Moab, Edom, Philistia, Tyre, Sidon, and Egypt, who are threatened with the wrath of Jehovah for their hostility to Israel. The remaining portion of the book, written after the destruction of Jerusalem, refers principally to the future of the Jewish nation, and contains a series of prophecies, visions, and directions for the guidance of the people after the coming restoration to their own land.

Despite a tradition contained in the Talmud to the effect that the men of the Great Synagogue "wrote" the book of the prophet Ezekiel, its genuineness is almost universally admitted. The book bears unmistakable marks of the individuality of the prophet throughout, notwithstanding the wonderfully varied nature of the predictions. By the Jews Ezekiel is classed among the highest of the prophets, though from the mystical character of some portions of his book it was placed, with Canticles, &c., among the treasures which might not be read before the age of thirty. Ezekiel is not referred to or quoted in the New Testament, but the influence of his style is manifest in several places in the Book of the Revelation.

EZ'RA. The name of a learned scribe and priest of the Jews who lived during the reign of Artaxerxes Longimanus. He occupies a very prominent place in Jewish tradition, but all that is really known of him is contained in the four concluding chapters of the Book of Ezra and in chapters viii.–xii. of the Book of Nehemiah. From these records we learn that he possessed considerable influence with the king, Artaxerxes, from whom he obtained permission to visit Jerusalem, and by whom he was invested with extensive powers for the benefit of his countrymen. Setting out from Babylon with a large company of Israelites, which included priests, Levites, singers, porters, &c., bearing with them many valuable gifts from the Israelites resident in Babylonia, they reached Jerusalem after a journey of four months. Here he found that the Israelitish people of all ranks had intermingled with the people of the land to such an extent as to threaten the subversion of both their nationality and religion. By his efforts these marriages were set aside, and then there is an abrupt break in the narrative extending for a period of thirteen years. The next appearance of Ezra is in connection with a solemn publication of the law before all the people, and with the celebration of the feast of tabernacles, and with this the record of his life comes to an end so far as the books of Scripture are concerned. Concerning his death there are several traditions, but none of them are trustworthy.

By the Jews Ezra is regarded as being the founder of the Great Synagogue, a somewhat mythical assemblage to which many things are ascribed; as being the compiler and editor of the sacred books of the Old Testament, the founder of the order of scribes, and the first to institute the services of the synagogues. That he exercised considerable influence upon the public and religious life of the Jewish nation is admitted by all modern scholars, but the extent of his labours in connection with the sacred Scriptures is a matter upon which there exists a wide divergence of opinion.

EZ'RA, BOOK OF, a canonical book of the Old Testament, placed in the English version after the Second Book of Chronicles, and divided into ten chapters. There are four books which bear this title—viz. the canonical book referred to, the Book of Nehemiah, which by the ancient Jews, and by the Greek and Roman Catholic churches, is considered as the second book of Ezra, and two books of Ezra or Esdras in the Apocrypha. The first of the two apocryphal books contains the substance of the canonical one, with many circumstantial additions, and in the Greek Church it is read as canonical. The second is of a more mythical character, and is not accepted as inspired by any church, though it is frequently quoted in patristic writings. The events recorded extend over a period of ninety-one years, and the narrative forms a continuation of the Second Book of Chronicles. Like the Book of Daniel it is written partly in Hebrew, partly in Chaldee. The Chaldee begins at the eighth verse of the fourth chapter, continues to the end of the eighteenth verse of the sixth chapter, and reappears again in chap. vii. 12–26.

Like the books of the Chronicles those of Ezra and Nehemiah are manifestly compilations derived from many sources. Official records, and earlier histories, genealogies, and personal memoirs, are all drawn upon for the purposes of the compiler, the object being to give an account of the restoration of the worship of Jehovah at Jerusalem, and to extend the influence of the priests and Levites. The text of these books has come down in a somewhat impure state, and there are many palpable corruptions in names, numerals, and certain other points.

F

F is a labial surd spirant, bearing the same relation to its sonant companion V which the letters called *tenues*, *p*, *k*, *t*, bear to the *mediæ*, *b*, *g*, *d*, and having *th* as its relative lingual. (These terms are explained under PHONOLOGY.) It occupies the sixth place in the English as in the Latin alphabet. As a character it is very ancient, and is derived from the hieroglyphs of Egypt, through the Phœnicians. F was originally the picture of a horned viper, the arms of the letter still figuring in the two side strokes.

The letter *F* is interchangeable with *ch* or *h* and *th*, and also with *p*, *b*, and *v*.

1. *F* in Latin corresponds to *h* in Spanish, as Latin *formosa*, beautiful; Spanish *hermosa;* Latin *fugere*, to fly; Spanish *huir.*

2. *F* in Latin corresponds to *th* in Greek, as Latin *fera*, a wild beast; Greek *θήρ.*

3. *F* in Latin corresponds to *b* in German and English, as *frangere*, *brechen*, *to break; frater*, *bruder*, *brother; fero*, *to bear.*

4. *F* in English and German to *p* in Latin, as *pelli*, *fell*, *fell* (comp. *fell*monger); *ped*, *fuss*, *foot; pugnare*, *fechten*, *to fight*, &c.

5. In English itself *f* frequently becomes *v*, as fox, vixen; and conversely, as five, fifty. It tends to disappear in the midst of words, thus *hlaford* (Old English) becomes *lord*, *wifmen* becomes *wimen* (women), *hafoc* becomes *hawk.*

F is also the symbol of the digamma or vau, which likewise occupied the sixth place in the ancient Greek alphabet; for while *epsilon* is employed as the numerical symbol of *five*, the next letter, as that alphabet is now arranged, is the representative of *seven.* Moreover, this position of the digamma will correspond precisely with that of *vau* or *waf* of the Hebrew, and of *f* in the Latin alphabet, two letters of kindred power and form. The letter still exists in many inscriptions. With regard to the power of the letter, it is now the general and well-established opinion that it is equivalent to our own *w.* See DIGAMMA.

F, in music, is the fourth note of the so-called "natural" scale of C, and the sixth of the relative minor scale of A. It is the sixth of the letters used in music. If F is used as a keynote, the signature of the major scale is one flat (B♭), and of the minor scale four flats (B♭, E♭, A♭, D♭). The relative minor to F major is D minor (with one flat as a signature). The note F, C being *Do* or *Ut*, as in French, becomes *fa;* this must not be confused with the tonic sol-fa use of the syllable *fa*, however, which signifies not only F as the fourth of C, but any fourth of any scale whatever. In French F is *fa;* F♯ *fa dièse;* Italian *fa*, *fa diesis;* German *F*, *fis.* F major is in German *F dur*, and F minor *F moll.* In the ancient Greek music F is the tonic of the Æolian mode; in the ecclesiastical system, that of the Lydian (with all white notes containing B♮ therefore). F is used as an abbreviation for *forte*, loud (*f*), and for *fortissimo*, very loud (*ff*). The bass stave is constructed round the ancient F line (a fifth below middle *c*), which line bears a modified letter F, as described under CLEF. The sound-holes of violins, &c., are called from their shape *f*-holes.

FA'BIAN, ST., is memorable as the first Bishop of Rome (pope) who is known authentically to have suffered martyrdom. He perished in the persecution of the Emperor Decius, A.D. 249.

FA'BIUS MAX'IMUS, FABIAN GENS. The Fabii were a powerful gens or patrician house of ancient Rome, which became subdivided into several families or branches distinguished by their respective cognomina, such as Fabii Maximi, Fabii Ambusti, Fabii Vibulani. They were of Sabine origin. Cæso Fabius, being quæstor with L. Valerius, impeached Spurius Cassius, 486 B.C., and had him executed. For seven consecutive years from that time one of the two annual consulships was filled by three brothers Fabii in rotation. Niebuhr has particularly investigated this period of Roman history. ("History of Rome," vol. ii.; "The Seven Consulships of Fabii.") In 479 B.C. the whole house of the Fabii proposed to leave Rome and settle on the borders of the territory of Veii, in order to undertake the war against the Veientes. They left Rome in a body, mustering 306 patricians, besides their families, clients, and freedmen, and encamped on the banks of the Cremera in sight of Veii. There they fortified themselves, and maintained for nearly two years a harassing warfare against the Veientes and other people of Etruria. At last in one of their predatory incursions they fell into an ambuscade, and were all killed. (Livy, ii. 48, 50; and Niebuhr's "History on the Veientine War.") One only of the house, Quintus Fabius Vibulanus, who had remained at Rome, escaped, and became the parent stock of all the subsequent Fabii. He was repeatedly consul, and was afterwards one of the decemviri with Appius Claudius for two consecutive years. M. Fabius Ambustus was consul in 361 B.C., and again several times after. He fought against the Hernici and the Tarquinians, and left several sons, one of whom, Quintus Fabius Maximus Rullianus, attacked and defeated the Samnites (year 325 B.C.) in the absence and against the orders of his commanding officer, the dictator Papirius, who would have brought him to punishment for disobedience, but was prevented by the interposition of the soldiers and the people. This Fabius was five times consul, and dictator twice. His son Quintus Fabius Gurges was thrice consul, and was the grandfather of Quintus Fabius Maximus Verrucosus or Ovicula, or (his best known *agnomen*) Cunctator (the delayer). This famous man in his first consulate triumphed over the Ligurians. After the Thrasymenian defeat he was named prodictator by the unanimous voice of the people, and was intrusted with the safety of the republic. The system which he adopted to check the advance of Hannibal was by avoiding a general engagement and harassing the enemy. This mode of warfare, new to the Romans, acquired for Fabius the name of Cunctator or "temporizer," and was censured by the young, the rash, and the ignorant. Minucius, who shared with Fabius the command of the army, having imprudently engaged Hannibal, was saved from destruction by the dictator. In the following year, however, 218 B.C., Fabius being recalled to Rome, the command of the army was intrusted to the consul Terentius Varro, who rushed imprudently to battle, when the defeat of Cannæ made manifest the wisdom of the dictator's caution. Fabius was made consul in the next year, and again kept Hannibal in check. In B.C. 211 (year 543 of Rome), being consul for the fifth time, he retook Tarentum by stratagem, after which he narrowly escaped being caught himself in a snare by Hannibal near Metapontum (Livy, xxvii. 15, 16). Fabius died B.C. 208 at a very advanced age. Many other consuls, &c., of this illustrious house dignify the history of Rome.

FA'BIUS PICTOR, QUINTUS, the historian, was descended from Marcus Fabius Ambustus the consul. Caius Fabius, one of the sons of Ambustus, was the first Fabius called Pictor, because about 304 B.C. he painted the temple of the goddess of health, which painting existed till the reign of Claudius, when the temple was burned (Pliny, xxxv. c. 4). From this Caius all the Fabius Pictores descended.

FABLE (Lat. *fabula*), in its general sense means a fictitious narrative, but it also means more particularly a species of didactic composition, consisting of a short fictitious tale, which inculcates a moral truth or precept. As such it is sometimes divided into sorts, the parable and the APOLOGUE. The parable, according to this division, narrates some incident, which, although it may not have happened exactly as the narrator supposes, yet could have happened, there being nothing impossible or improbable in it. Of this description are many of the parables contained in the New Testament. The second species of moral fable, called apologue, relates facts which are evidently untrue, and cannot have happened—such as animals, or even inanimate things, speaking—but which serve as comparisons for the actions of men. Most of the fables which are called Æsopian are apologues, although some are of the parable kind; for example, that of Æsop and the villain who threw a stone at him. (Phædrus, iii. 5.)

The oldest collection of fables in any European language is in Greek prose: they are the fables attributed to ÆSOP. Babrius made a metrical version of Æsopian fables. The fables called the fables of Bidpai or Pilpay are of Eastern origin. See PILPAY.

Among the Latins, Phædrus, who lived under Tiberius, is the most celebrated: he professes to have taken his subjects from Æsop. Among modern original writers of fables, La Fontaine ranks above all writers of this class. Among the English Roger L'Estrange, Gay, and Moore have written the best fables. The Germans have had Lessing, Gellert, and others; and the Spaniards Yriarte and Samaniego. Among the Italians, Firenzuola, Crudeli, Baldi, and Capaccio, in the sixteenth and seventeenth centuries, wrote chiefly translations or paraphrases from the Greek and Latin fabulists. In the eighteenth century Pignotti, a native of Tuscany, wrote original fables in verse, which were published at Pisa in 1782, and have been often reprinted since. Bertola also wrote fables (Pavia, 1788), with an essay on fables. Luigi Fiacchi published, under the name of "Clasio," a collection of fables (Florence, 1807). The most successful of late fabulists is the Russian Kriloff.

FABLIAU, a popular short metrical narrative much in vogue among early French poets, and dealing with passing events. The fabliaux were generally racy with satire and humour, and from them chivalry and church suffered much ridicule. The fashion was originally derived from the East, whence Boccaccio and other writers drew many of their tales, and from the fabliaux and their allies the FARCES modern French comedy may be said to descend. Several collections of fabliaux have been made, among which may be mentioned that of Barbazan (published in Paris in 1756) and that of Jubinal (Paris, 1839–43).

FABRE, COUNT JEAN PIERRE, a French politician, was born in 1755. He was originally an advocate in the Parliament of Toulouse in 1783, was sent as a deputy to the estates of Languedoc, and held in succession various local offices. He quitted France during the Reign of Terror, but returned after the fall of Robespierre, and obtained a seat in the Council of Five Hundred. He afterwards attached himself to the fortunes of Bonaparte, was appointed successively president of the tribunat, commander of the legion of honour, a member of the senate, a count of the empire, and procurator-general of the council. In 1814 he was one of the first to turn against Napoleon, but he joined him once more on his return from Elba. He opposed, however, the proposal to confer the crown on Napoleon's son, and declared in favour of the second restoration of the Bourbons. He was restored to his place in the chamber of peers in 1819, and died of cholera in 1832.

FABRIANO, GENTILE DI NICCOLO DA, one of the most distinguished Italian painters of the fifteenth century, and of the Umbrian school, was born at Fabriano in the march of Ancona, about 1370. He was the scholar of a fellow-townsman in painting, known as Gritto da Fabriano. Having distinguished himself in his own province, his reputation gradually extended itself to the greatest cities of Italy, and he executed many works at Orvieto, Florence, Siena, Venice, and Rome. He painted in fresco and in tempera; and though he devoted much attention to costume and gilding, showed a fine taste, and was one of the first to venture to deviate from the almost exclusively formal religious art of his time. His pictures are richly coloured and well executed, or sufficiently so to draw the well-known compliment from Michael Angelo, that his works were like his name—*gentile*. He is styled in the register of the cathedral of Orvieto, 1425, *egregius magister magistrorum*. At Venice he was presented by the senate with a patrician toga, and granted a pension of a ducat daily, for his fresco of the victory of the Venetians over Barbarossa in 1177, painted in the grand council hall; it fell to pieces through damp about a century and a half after it was painted. Gentile had been instructed by his father in the physical and mathematical sciences, and was as distinguished in the theory as in the practice of his art. He wrote some books on the origin and progress of painting, and on the mixing of colours, &c., now lost. His works are very rare; a few may be seen at Fabriano, Florence, Milan, and in the Louvre. He died at Rome about the year 1450. Gentile da Fabriano, Fra Angelico da Fiesole, and Massaccio were the foremost masters of the Italian renaissance in painting.

FABRI'CIUS, CAIUS, surnamed *Luscinus*, was consul for the first time in 283 B.C., when he triumphed over the Boii and the Etruscans. Fabricius is one of the favourite heroes of early Roman legend. After the defeat of the Romans under the consul Lævinus by Pyrrhus (281 B.C), Fabricius was sent by the senate to the king to treat for the ransom of the prisoners, or, according to others, to propose terms of peace. Pyrrhus is said to have endeavoured to bribe him by large offers, which Fabricius, though poor, rejected with scorn, to the great admiration of the king. Fabricius, being again consul (279 B.C.), was sent against Pyrrhus, who was then encamped near Tarentum. The physician to the king is said to have come secretly to the Romam camp, and to have proposed to Fabricius to poison his master for a bribe, at which the consul, indignant, put him in fetters and sent him back to Pyrrhus. Fabricius, having defeated the Samnites, Lucanians, and Bruttii, who had joined Pyrrhus against Rome, had the honour of a triumph. Pyrrhus, afterwards returning to Italy, was finally defeated and driven away by M. Curius Dentatus, 276 B.C. Two years after Fabricius was consul for the third time. Several instances are related of the simplicity of the manners of Fabricius, which are conformable to what is recorded of the austerity of Roman life previous to the Punic Wars. Fabricius died poor, and the senate made provision for his daughters. (Plutarch, "Life of Pyrrhus;" Livy, "Epitome," xiii., xiv.; Mommsen.) This is not the Fabricius who built the Pons Fabricius, now called *Ponte Quattro Capi*, at Rome. That was a descendant of the subject of this article, who was ædile in B.C. 62.

FABRI'ZIO, GIROL'AMO, commonly called *Fabricius ab Acquapendente*, was born in 1537 in Acquapendente in Italy, a city near Orvieto. His parents, although poor, contrived to furnish him with the means of obtaining

an excellent education at Padua. He became a pupil of Fallopius at an early age, and speedily attracted the attention and good-will of his instructor. He thus secured many peculiar advantages, of which he availed himself so well that he was appointed, on the death of Fallopius, in 1562, to succeed him.

His reputation as a teacher drew students from all parts of Europe, till at length the theatre of anatomy, built originally by himself, became so crowded that the Venetian senate provided him, in 1598, with another of ample dimensions at the public expense, and at the same time added largely to his salary, and granted him many exclusive privileges and titles of honour. The fame and wealth he derived from his practice as a surgeon were even more than equal to what he enjoyed as an anatomist; and, after upwards of fifty years of uninterrupted and well-deserved prosperity, he retired from public life the possessor of an enormons fortune and the object of universal esteem. Yet he does not appear to have found the contentment he sought in his retirement. His latter years were embittered by domestic dissensions and the unfeeling conduct of those who expected to become his heirs; and he died in 1619, at the age of eighty-two, not without the suspicion of poison, at his country seat on the banks of the Brenta, still known as the Montagnuola d'Acquapendente.

Fabricius was the tutor of William Harvey, whose discovery of the circulation of the blood was suggested, according to his own statement, by the remarks of Fabricius on the valvular structure of the veins.

He published many tracts on anatomy and physiology, which were collected in one volume folio, and republished, with a biographical memoir of the author by Albinus, at Leyden in 1738. The best edition of his surgical works, the twenty-fifth, was printed, also in one folio volume, at Padua in 1666. His writings are all in Latin, and display a considerable knowledge of the literature, general and medical, of that language and of the Greek.

FABRONI, ANGELO, born at Marradi on the 7th of September, 1732. His family followed the fortunes of the Medicis, and have been honourably mentioned by Varchi in his "History of Florence." Angelo was sent early to Faenza, where he studied under the direction of the eminent grammarian Girolamo Ferri, to whom he dedicated his first literary production, the "Life of Facciolati." His father's means being very limited, he obtained a bursary in the Collegio Romano; and after a successful career he went to Rome, where he fixed his residence in 1750, fully resolved never to return home until he had acquired a name worthy of his family. There he renewed his study of the classics under the direction of the Jesuits, and attained such a knowledge of Latin that he could write orations in that language with perfect facility. His style is considered very terse and brilliant, and decked in that elegance peculiar to the Augustan age. His fame as a Latinist and a biographer introduced him to many contemporary celebrities then visiting Rome; and Benedict XIV., before whom Fabroni pronounced many Latin orations, granted him his protection, and recommended him to the celebrated Bottari, who appointed him to the canonry of S. Teresa in Trastevere. Through the influence of the same pontiff, the Countess Palavicini settled on Fabroni an annuity that enabled him to devote his time to the study of the Roman law, on which he wrote a very erudite dissertation. His "Lives of the Literary Men of Italy," published in 1766, are cited as models of style. To this work, and particularly to the "Life of Lorenzo de Medici," he owed his election to the Academy of La Crusca. Having reached the summit of literary renown, he died at Pisa on the 22nd September, 1803.

FA'BYAN, ROBERT, the chronicler, was descended of a respectable family of Essex. Bishop Tanner says he was born in London. We have no dates of his early life, but he belonged, as a citizen, to the Company of Drapers; he was alderman of the ward of Farringdon Without; and in 1493 he held the office of sheriff. In 1502, on the plea of poverty, he resigned the alderman's gown, not willing to take the mayoralty, though he was probably opulent at this time, but he seems to have considered that the expenses of the chief magistracy were too great to be sustained by a man who had a numerous family. Fabyan died in 1512.

There have been printed five editions of Fabyan's "Chronicle." The first was printed by Pynson, in 1516, and is of great rarity in a perfect state. The first edition had no regular title; the latest is called "The New Chronicles of England and France, in two parts, by Robert Fabyan, named by himself the Concordance of Histories." Fabyan was a good Latin and French scholar, and usefully translated and compiled his account from the monkish chronicles. It runs from Brut, the mythical founder of Britain, to the year 1504, and is in prose and wholly in English, any quotations being always translated. Though not credulous, Fabyan is a good son of the church, calls A'Becket a "blessed saint" and Henry II. a "hammer of holy church," &c.

FAÇADE, a French term of modern introduction into the English language. It expresses the face or front view of an edifice, and is often used in speaking of important buildings, as the façade of the Louvre, or the façade of St. Peter's at Rome.

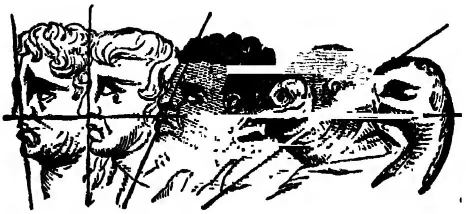
FACE, FACIAL ANGLE. Scarcely any animal but man and some of the catarrhine apes can really be said to have a face. The level eyes, separated by the small nose, and surmounted by a wall of forehead, the mouth with its incisors almost square across, the broad chin, go to make up a considerable surface somewhat in one plane; and this surface is covered with the most mobile muscles reflecting every shade of expression. In speaking of a beautiful woman or of a handsome man nine persons out of ten in an ordinary way are qualifying the face alone, so exclusive is the attention paid to this part of the frame. Half the amusement that a kitten's tricks afford is due to the playing of such antics with so immovable a face. In the article DRAWING the muscles of the mouth, &c., are specially considered, and are given in detail in the Plates illustrating that article; and in the article EXPRESSION OF EMOTION enough will be found to show the wonderful superiority of man over other animals in that particular, because of the facial arrangement of his skull.

But in addition to the muscularly expressive character of the face when viewed from the front, its bony contour, and especially its profile, is of no less importance. This varies widely in different races of men, and the variations depend chiefly on two points, the development of the cerebral hemispheres [see BRAIN] and of the jaws.

The facial angle is an angle of the face consisting of two imaginary lines—the one perpendicular, or nearly so, and the other horizontal. The former touches the most prominent part of the forehead, while the latter passes over the meatus auditorius, or opening of the ear, and terminates at the extremity of the alveolar process of the upper jaw. It was the invention of Camper, a celebrated Dutch physician and naturalist, who, during the middle of the last century, wrote an unusually ingenious treatise on "The Physiognomy of Men of different Nations," and conceived the idea which the phrenologists now entertain, that the degree of intellect was according to the angle formed by those two lines. Thus the ancient Greeks appear to have had the largest frontal development and the Carib Indians the least. In the same manner, when we descend to the inferior animals of creation, we find the cerebral angle depressed according to the degree of stupidity by which the animal is distinguished. Thus the annexed outline of the Greek, the Roman, the negro, the

monkey, and the goose will illustrate the facial angles of each, and exhibit the different gradations of cerebral depression from the highest to the lowest degrees of intellect.

According to this scale we shall find that the usual angle of the mythological gods and heroes of the Greeks exceeded the perpendicular line of 90°, which shows the opinion the Greek artists entertained of that peculiar development being indicative of high intellect. The usual angle of Europeans is from 80° to 90°; that of the negro, from 70° to 80°; and of the monkey and goose, considerably lower. In all antique busts we find that the ancient Greeks are usually represented with very prominent foreheads, at about an angle of 90°, and their gods frequently



The Facial Angles.

as high as 100°; but the facial angle of the Romans and their western successors is represented at about 85°.

In physiology, the term *facial* is variously applied; for instance, the bones of the face (thirteen in number), exclusive of the teeth, are called the *facial bones*. The three principal divisions of face are termed the *facial muscles*, and the nerve with which those muscles are supplied, and which rises from the lower and lateral parts of the pons varolii, is termed the *facial nerve*. The vein which passes obliquely across the face, and terminates in the internal jugular, is called the *facial vein*.

FA'CET (Fr. *facette*), among lapidaries and jewellers, the name of the little faces or planes which are ground in diamonds and other brilliants. It is by means of the facets that the glittering brilliancy of the diamond is produced at every change of the face or angle of the facets. In mineralogy the minute faces of crystals are called facets; and in zoology the compound eyes of insects are termed facet-eyes, each eyelet being a facet.

FAC'TIONS OF THE CIRCUS. These arose from the chariot racers of the Romans being distinguished by liveries, as our jockeys are, but with this distinction, that the colours were unchangeable. White contested with red. Afterwards, under later emperors, four chariots ran at once, and blue and green were added. Poets likened the well-known white, green, red, and blue of the circus to the snows of winter, the verdure of spring, the flaming heat of summer, and the cooler skies of autumn. Political hatreds availed themselves of these factions of the circus, till the word faction took its present exclusively political colour. Theodoric interposed his imperial authority to protect the "greens" from the violence of a consul who was a violent "blue;" and under Anastasius the "greens," mustering in force with concealed weapons, massacred 3000 "blues" at a certain festival. In the late-empire of Constantinople "greens" and "blues" are as every-day political words as our Whigs and Tories, but always retaining their connection with the circus games. Under Justinian the "blues" were high Tories, imperialist and orthodox; and proud in the favour of the prince, they overawed Constantinople to such an extent that many "greens" fled into exile to avoid assassination and robbery. At last the "greens" protested in the circus itself at the terrible dangers they ran. The emperor held a long conversation with them through a herald; it degenerated into an altercation, and his favourite "blues" rose and drove the "greens" from the circus. In the riot which followed Constantinople was set on fire and a large part of it burnt, including the cathedral of the Holy Wisdom (Sancta Sophia). For a brief time Justinian was dethroned, but eventually recovered his throne and had his rival (Hypatius) put to death. Over 30,000 perished in the last and worst of the five days of anarchy. Yet even after this terrible warning the emperors found it impossible to put down those unruly factions, which long continued to afford pretexts for frequent disturbances.

FACTOR, a name give to any algebraical expression considered as a part of a product. Thus a and $a+x$ are the factors of the product $a\ (a+x)$, or a^2+ax. So also 4 and 3 are factors of 12. So also 1 and 12, 2 and 6, $1\frac{1}{2}$ and 8, 2 and 2 and 3, &c., are also factors of 12, whence we see that an expression may be resolved into more than one set of factors.

FACTOR, a mercantile agent who buys and sells the goods of others, and transacts their business on commission. He is intrusted with the possession, management, and disposal of the goods, and he buys and sells in his own name, in which particulars consists the main difference between factors and brokers. See Broker.

The chief part of the foreign trade of a country is carried on through the medium of factors, who generally reside at a distance from the merchants or manufacturers who employ them. The common duty of a factor is to receive consignments of goods, to sell them, and to make remittances either in money, bills, or purchased goods in return; and he is paid by a commission upon the money which passes through his hands. It is usual for a factor to make advances upon the goods consigned to him, for which, and for his commission, he has a general lien upon all the property of his employer which may at any time be in his hands.

It is the duty of a factor to keep the goods with which he is intrusted free from injury, to keep a clear account of his dealings, and at proper times to transmit it to his employer, with information of all the transactions and liabilities which he has entered into and incurred in the course of his employment by which his principal can be affected; also to send him advice of all bills accepted or drawn upon his credit, and generally to act with fidelity to him, strictly observing the letter or the spirit of his instructions, and, where they are silent, following the ordinary prudent course of other merchants who deal in like commodities, as to time and mode of sale, credit, &c. A factor is not answerable in all cases for the safety of the goods in his care; it is sufficient if he does all that a man of ordinary prudence would do in the care of his own goods. He is bound, upon receiving notice from his principal, to insure the goods consigned to him (provided he has effects of his principal in his hands of sufficient amount to defray the premium), to discharge the duties payable upon the exportation or importation of the goods, to cause the regular and necessary entries to be made at the custom-house, and do all other things necessary for the safety and preservation of the goods.

Where general and unlimited orders are given to a factor, he may buy and sell on the best conditions that he can. It was formerly a rule of law that a factor had only authority to sell the goods of his principal, and that if he pledged them the principal might recover them from the pledgee. But now the pledgee of a factor, when he lends his money without notice that the factor is not the owner of the goods, is enabled to retain them for his security; and, even when he has such notice, the lender has a lien upon the goods to the same amount as the factor was entitled to. And by 5 & 6 Vict. c. 39, a pledge by a person who is known to have received the goods or documents as the agent of the owner for the purposes of sale will be perfectly

valid. See also 24 & 25 Vict. c. 95, 96, and 40 & 41 Vict. c. 39.

When a sale is made by a factor, the principal may maintain an action against the buyer for the price, and may by notice direct him not to pay the money to the factor, which notice the buyer is bound to attend to. A purchase by a factor for his principal renders the latter liable to the vendor, though a payment to the factor is a sufficient discharge, unless notice to the contrary has been given by the principal. And this holds good in both cases, even when the name of the principal is not disclosed at the time of the contract, but is afterwards discovered; though, where a factor conceals the name of his principal and buys or sells apparently on his own account, the buyer or seller may treat the factor as the principal so far as any other liability of the factor may exist to him; as where a factor sells goods in his own name, being indebted to the purchaser, the latter may set off the amount of debt due to him from the factor against the price of the goods.

There is another description of factor who acts under what is called a *del credere* commission, where, for an additional percentage, he engages for the solvency of the purchasers of the goods consigned to him. [See AGENT.] In this case, the factor stands in the relation of a surety for the persons with whom he deals on account of the employer, and he is liable to his employer only in case of their default. *Del credere* is an Italian mercantile phrase, of the same signification as the English word *guarantee* and the Scotch *warrandice*.

When goods are consigned to joint factors, they are answerable for one another for the whole.

The principal may recover against his factor by action for the neglect of his duty, or disobedience to his instructions, if loss occur thereby; as if he purchases goods at a limited price, and fraudulently sells them again for his own profit. If a factor, without the orders of his principal, exports goods prohibited by the customs laws, and the same are seized, the loss is the factor's; and if he pays money without the direction of his employer, or sells his goods at an undervalue, or exports goods of an improper quality, he is answerable for the damage. And if a factor exports goods of a different quality or kind from those he was directed to purchase, or sends them to a place other than that to which he was ordered to send them, the merchant may refuse to accept them, and may recover from the factor any damage he has sustained in consequence of his neglect. The rights and liabilities of merchants and factors are governed by the law of the place in which they are domiciled, and any contract which may be made by either of them must be governed by the law of the place where it is made; and these rules are acted upon by the courts of justice of every nation. In Scotland the word *factor* is often used to mean the manager of real property, and in that sense corresponds to the English *land steward*. It also denotes an officer judicially appointed to manage estates, whether real or personal, *e.g. judicial factor*, or *factor loco tutoris*.

FACTORY and FACTORY ACTS. The name of factory was formerly given only to establishments of merchants and factors resident in foreign countries, who were governed by certain regulations adopted for their mutual support and assistance against the undue encroachments or interference of the governments of the countries in which they resided. In modern times these factories have in a great measure ceased to exist, on account of the greater degree of security which merchants feel as regards both the justice of foreign governments and the protection, when needed, of their own country.

The Venetians, Genoese, Portuguese, Dutch, French, and English have all had establishments of the nature of factories. In most instances their proprietors at first obtained the privilege of trading, and afterwards procured for the precincts assigned to them some exemption from the jurisdiction of the native courts. In that state of things the supreme government of the country whose subjects established the factory prepared laws for its control and administration, and treated it, in fact, as if it were its dependency, though the sovereignty of the native government was undisputed.

In its usual acceptation the word factory has now a different meaning, and is generally applied to any large building in which associated labour is carried on. The factory system owes its origin to the invention and skill of Arkwright; and it is probable that but for the introduction of spinning machinery, and the consequent necessary aggregation of large numbers of workmen in cotton-mills, the name would never have been thus applied. It is in the cotton-mills of England and America that the system has been brought to its highest state of perfection. Its chief recommendations over the old system of individual work at home, are the subdivision of employment according to strength and skill; the rapidity and ease with which persons soon learn to accomplish the one branch of a manufacture on which they are exclusively employed; the opportunities which all factories afford of using every kind of waste and refuse in some way or another; the decrease in the cost of production, and greatest uniformity in the articles manufactured. But although much may be said in favour of the system from a merely politico-economical point of view, it must be admitted that it has its serious drawbacks and defects, the most noticeable of which are its tendency to make the worker or "hand" more or less a human machine, and to widen the chasm between the employer and employed by making it extremely difficult for the latter to rise above the position of a workman, on account of the large capital required to establish a factory, on however small a scale. Owing, too, to the fact that very young persons can often earn as much, or even more than their older companions, factory operatives are often tempted to enter upon the married state while really mere boys and girls; and nothing is more common in the manufacturing districts than for both parents, and those of their children old enough to do so, to be employed at the mills. Domestic happiness and comfort are thus often sacrificed, the younger children neglected, and family affection weakened. In fact, to such an alarming extent were even very young children formerly employed, with scarcely any regard to their health, education, or comfort, that from motives of humanity the legislature passed several statutes for preventing their being tasked beyond their strength, to the permanent injury of their constitutions, and also to regulate their hours of work and promote their education.

The first law enacted for the purpose of regulating labour in factories was the Act for the Preservation of the Health and Morals of Apprentices in Cotton and other Factories (42 Geo. III. c. 73), 1802. This Act required the cleansing and ventilation of factories, prohibited nightwork and excessive labour in the day, and regulated the supply of clothing, and of secular and religious instruction to the apprentices. This measure proved inoperative owing to the want of the necessary provisions for carrying it into effect, and to its limited application to parish apprentices.

The introduction of steam power instead of water power to move spinning frames and looms gave a great impetus to the building of factories, especially in populous towns. The evils of excessive labour then became painfully evident. A Parliamentary inquiry in 1816 afforded for the first time a circumstantial description of the injurious action of factory labour on children, and of the grasping efforts of parents to derive profit and income from the children's wages, and led to the passing in 1819 of 59 Geo. III. c. 66. This Act applied to cotton-mills only, and limited the age at which children might be admitted into factories, and restricted

the hours of labour to twelve each day. Several supplementary statutes were added to this Act, shortening the Saturday labour, and stipulating penalties against transgressors. The further development of factory industry and the enormous increase in wool spinning, not then subject to any effective legal restriction, were conducive towards bringing to light the evils resulting from overwork, and an agitation sprung up having for its object the passing of a Ten Hours Bill.

In 1833 another Factory Act (3 & 4 Will. IV. c. 103) was passed, which prohibited nightwork to all persons under eighteen, and fixed the maximum number of hours for children under thirteen at forty-eight per week, and for young persons at sixty-nine. This Act provided for daily attendance at school of children, for six days' holiday in the year, for the medical examination of children, and for the appointment of four inspectors to carry out the law; and applied to cotton, woollen, linen, and silk mills. Owing to difficulties experienced in enforcing this Act, and in consequence of a report of the Children's Employment Commission, 1843, a further Act to amend the Laws relating to Labour in Factories (7 & 8 Vict. c. 15) was passed in 1844. This Act reduced the working time for children between eight and thirteen years of age to six and a half hours per day, and placed adult females under the same legal protection as young persons. One hour and a half was to be allowed for meal times, and all protected persons were to take their meals at the same time in the day. Parents were required to send their children to school for three hours a day, and employers to obtain weekly certificates of such attendance. Mill-gearing was not allowed to be cleaned while in motion, and all machinery was to be guarded. For the purpose of carrying out the law, the factory inspectors were increased in number, and invested, under the administrative control of the home secretary, with extensive powers. By this Act the working hours of women and young persons were twelve per day, but in 1847 the agitators for a Ten Hours Bill succeeded in passing an Act limiting the time for labour to ten hours a day and fifty-eight hours a week. As the ten hours might be taken any time between 5.30 a.m. and 8.30 p.m., this law was evaded, and in 1850 a compromise was effected by the 13 & 14 Vict. c. 54, which reduced the legal working day for all young persons and women to the time comprised between 6 a.m. and 6 p.m., and fixed the legal hour and a half for meal times within these twelve hours, so that the real working time during the first five days in the week was increased to ten and a half hours a day. On Saturday no protected person was allowed to work after 2 p.m. This law, by its clear and distinct provisions, put a speedy end to the uncertainties and agitation that existed in the textile districts, and met with less resistance than had been expected. The employers gained two hours a week, sixty instead of fifty-eight, and the operatives gained the much-prized boon of a Saturday half holiday. Other Acts were passed in 1853, 1856, 1860, and 1861, regulating the children's working day, providing additional means of safety against dangerous machinery, and subjecting bleaching and dyeing works and lace factories to the Factory Acts' regulations.

In 1861 a royal commission was appointed to inquire into those industries not yet under legislation, and to propose suitable enactments. This commission laboured with extraordinary diligence from 1862 to 1866, and published the result of their labours in five large volumes. The first report was issued in 1863, and consequent upon that report the provisions of the Factory Acts were extended in 1864 to the manufacture of earthenware, lucifer matches, percussion caps, cartridges, paper staining, and fustian cutting. Clauses were added, requiring every factory to be kept in a cleanly state and to be well ventilated, and empowering the occupier to make special rules compelling the workman, under penalty of a fine, to observe the conditions of cleanliness and ventilation. Four other reports were laid before Parliament in 1864–67, containing inquiries into 150 different trades, revealing a mass of ignorance and oppression which startled the public mind, and leading to a greater extension of the Factory Acts than had previously been dreamt of.

The Factory Acts Extension Act 1867 (30 & 31 Vict. c. 103) extended the application of the Factory Acts to blast furnaces, copper and iron mills, iron and brass foundries, machine and metal works, india-rubber works, paper mills, glass works, tobacco manufactories, letterpress printing-offices, bookbinders' shops, and to any premises constituting one trade establishment, where fifty or more persons were employed at any manufacturing process.

In the same session was also passed the Workshop Regulation Act, 1867, whereby workshops, or places other than factories, in which any handicraft was carried on, were made subject to provisions similar to those of the Factory Acts. It was made the duty of the local authorities to enforce this Act in workshops, and they generally shrank from the trouble and expense of doing so. In 1871 the duty was transferred to the inspectors of factories.

The passing of these two statutes of 1867, extending as they did the principles of the Factory Act to almost every kind of labour, was an important epoch in the history of factory legislation, and affected the well-being and condition of about 1,500,000 persons.

Restrictions in the employment of children in agriculture were provided for by the Elementary Education Acts, and labour in mines is regulated by the Mines Regulation Act.

In 1875 another royal commission was appointed to inquire into the operation of the Factory and Workshop Acts, with a view to their consolidation and amendment. This commission recommended that all the Acts, then numbering sixteen, should be consolidated into a single statute, and the provisions thereof extended to all kinds of labour except mining, agriculture, and domestic. The commissioners also recommended that the minimum age at which a child should be allowed to be employed should be raised from eight to ten. Accordingly the Factory and Workshop Act, 1878 (41 Vict. c. 16), was passed, which repealed all previous Acts, and consolidated them into one comprehensive statute. This Act deals with textile factories, non-textile factories, and workshops. A factory is a place in which machinery is moved by the aid of steam, water, or other mechanical power. The term non-textile factory also includes the occupations enumerated in the Acts of 1864 and 1867, whether using power or not, and includes in addition all unnamed occupations in which mechanical power is used. All the unnamed occupations in which power is not used, except those especially named in the Acts of 1864 and 1867, are defined to be workshops.

The following is an analysis of the regulations of the Factory and Workshop Act, 1878, as amended by the Factory and Workshop Act, 1883 (46 Vict. c. 53):—

Sanitary Provisions.—Every factory is to be kept in a cleanly state, free from effluvia, to be well ventilated, not overcrowded, and to be lime-washed once in fourteen months; means are to be provided to prevent persons being wetted in wet spinning, and to prevent the escape of steam; and where dust is generated by grinding, glazing, or polishing, a fan is to be provided for preventing the inhalation of dust. The Act of 1883 also provides special sanitary regulations for bakehouses and white-lead factories.

Safety and Accidents.—In all factories, steam-engines, water-wheels, mill-gearing, and dangerous machinery must be securely fenced.

No child, young person, or woman is allowed to clean any mill-gearing while it is in motion, or work between the fixed and traversing part of any self-acting machine while it is in operation. If any accident occur in a factory

which shall cause serious bodily injury to any person employed, a written notice thereof must be sent within forty-eight hours of the accident to the certifying surgeon, who is required to investigate the nature and cause of such accident, and report thereon to the inspector. For this purpose the surgeon has the same power as an inspector, and may enter any room to which the injured person has been removed.

The secretary of state may empower an inspector to direct an action to be brought on behalf of the person injured for the recovery of damages, which are to be paid to the person injured or for his use and benefit, in such manner as may be approved of by the secretary of state.

Employment and Meal Hours.—It is illegal to employ a child under ten years of age in a factory under any circumstances. Children between ten and fourteen must be employed either in morning and afternoon sets, or on alternate days, or, in other words, for half-time only. It is, however, provided that a child of thirteen years of age may be employed as a young person if he or she has obtained a certificate of having attained a prescribed standard of proficiency in reading, writing, and arithmetic. The Act further provides that the education of children shall be in schools recognized as efficient by the Education Department.

No child can be employed before six in the morning or after seven at night, or on any Saturday after half-past one in the afternoon, for any purpose whatever. No child can be employed more than six hours and thirty minutes in any day, except where young persons and women work ten hours, and notice thereof has been given to the inspector of the district, when children may be employed the same time on three alternate days of the week; but must not be allowed to work on two successive days.

No young person between fourteen and eighteen years of age, and no woman, can be employed in any factory except between either 6 a.m. and 6 p.m., or 7 a.m. and 7 p.m., on the first five days of the week. On Saturdays the actual working time must not exceed six hours, but half-an-hour is allowed for "clearing up." The week's work is limited to fifty-six hours and a half in textile factories, and to sixty in non-textile factories and workshops. The employment of children, young persons, or women on Sunday is prohibited.

In textile factories two hours must be allowed for meals, and no child, young person, or woman can be employed for more than four and a half hours without an interval of at least thirty minutes. In non-textile factories and workshops only one hour and a half is prescribed for meals, and a spell of five hours is allowed between meals. During the meal times no protected person may be employed in the factory, or allowed to remain in any room in which a manufacturing process or handicraft is then being carried on.

Holidays.—In England and Ireland no child, young person, or woman can be employed on Christmas Day, nor on Good Friday, unless Easter Monday is given as a holiday. In Scotland the Sacramental Fast Day and one other day may be substituted. In addition, eight half holidays, or equivalent whole holidays, must be given during each year.

Education of Children.—The parent or person having any direct benefit from the wages of any child under fourteen employed in a factory, must cause such child to attend daily for one school attendance when working in morning and afternoon sets, and for two school attendances when working on two alternate days. A school attendance is defined to be an attendance of not less than two hours' instruction in secular subjects. No attendance is required on Saturday. A child who has not in any week attended school as required, cannot be employed in the following week until he has made up the lost attendances.

The occupier of every factory in which a child is employed must, on some day appointed by the inspector, obtain a certificate that such child has attended school during the previous week.

Certificates of Fitness.—A boy or girl under sixteen years of age cannot be employed for more than a week unless the occupier of the factory has obtained from the certifying surgeon of the district a certificate, in the prescribed form, of the fitness of such child or young person for employment. This certificate is granted upon personal examination, and records date of birth, educational standard, and the surgeon's opinion that the person examined is not incapacitated by disease or bodily infirmity for working daily in the factory. Certificates of fitness are not required in workshops.

Miscellaneous Regulations.—An abstract of the Act is required to be hung up at the entrance of every factory or workshop, and in factories a register of children and young persons is to be kept. The hours of work are to be regulated by a public clock. Children are prohibited from working in annealing rooms of glass-works, in metal grinding and lucifer-match dipping; and girls under sixteen from working in brickyards or salt-works. Meals are not to be taken in certain parts of glass, earthenware, lucifer-match, and lead works. On the other hand modifications of the Act are allowed in certain manufactures, such as hours of work between 8 a.m. and 8 p.m. in various trades; overtime for two hours extra or not more than forty-eight days in the year, in certain trades where the material operated upon is liable to be spoiled by the weather, where press of work arises at certain recurring seasons of the year, or where the business is liable to sudden press of orders arising from unforeseen events. Male young persons are allowed to be employed at night in blast furnaces, iron-mills, letterpress printing works, glass-works, and paper-mills, subject to a weekly change from night to day work.

Government Inspection.—An office of factory inspectors is established in London, the gentlemen composing which have power to enter any factory when any person is employed therein, and any school in which children employed in factories are educated, and to take with them the certifying surgeon and any peace officer, and to examine every person whom they shall find in such factory or school, or whom they shall believe to have been employed in a factory within the preceding two months.

Fines.—Offences against the statutes are punishable by fine, complaints for the enforcement of which must be heard and determined by two or more justices. Any person convicted of having employed any person contrary to the provisions of the Factory Act, or of having employed a child without a certificate from a schoolmaster where required, such person, not being the parent or having any direct benefit from the wages of such child, is liable to a penalty of £3 for each child or young person so employed; and if such offence was committed during the night, to a penalty of £5. Parents who neglect to cause their children to attend school, are liable to a penalty of £1 for each offence. The penalty for not keeping the factory in conformity with the Act is £10, and for obstructing an inspector in the daytime £5, or in the night £20. All penalties imposed in pursuance of the Factory and Workshop Act, 1878, are to be paid into her Majesty's exchequer, and carried to the consolidated fund.

The results of English factory legislation have very generally commended themselves to all parties concerned. The manufacturers at first offered resistance to enactments which appeared to threaten them with serious loss, both through a diminution of the amount of goods manufactured and an increase of expenditure. The introduction of better machinery, and the increased steadiness and productiveness of labour, have, however, in great measure compensated

for the anticipated loss. The beneficial influences of the Factory Acts on the interests of the working classes manifested themselves in every direction, by improved health, longer lives, protection against accidents, regularity in system of working and mode of living, education of children, and means of moral and social elevation afforded by the shortening of the working days. Other countries are gradually adopting the same kind of legislation, and there are now Factory Acts of more or less stringency in France, Germany, Austria, Denmark, Norway, Sweden, and parts of Switzerland and British India.

FAC'ULÆ, in astronomy, are those brilliant streaks on the sun's surface which are the brightest part of it. They are best seen near the edge or "limb" of the disc, and more especially near sun-spots (comparatively dark portions of the sun's surface) when in the course of the revolution of the orb these approach the limb. The size of these brilliant *torches* (Latin *facula*, a torch) varies from 1000 to 40,000 of our miles long, and from a mere narrow ridge to 4000 miles broad. They are believed to be probably heaped up masses of the incandescent metallic vapours which form the sun's photosphere and give us light, just as the spots which they so frequently accompany may be hollows in that glowing vaporous mass; and it is evident that the same downward rush which would scoop out a sun-spot would of necessity pile up *faculæ* at its edges. While we reckon the faculæ by thousands of miles, we have often to reckon the sun-spots by millions however. The outer atmosphere of the sun, enveloping the photosphere, is believed to be highly absorptive. The faculæ therefore are bright because they pierce partly through that atmosphere towards us, and the spots dark because a greater thickness of solar atmosphere buries them.

FÆ'CES. The refuse food of the body, after the stomach and the intestines have taken up all that they can assimilate, accumulates in the sigmoid flexure of the colon or in the rectum, and acquires a peculiar odour the origin of which is not very clear. The fæces become more and more solid in character the longer they are retained in the bowel, but n the healthy subject are expelled before they become unmanageably hard, by a peculiar contraction of the abdominal muscles aided by the peristaltic action of the bowel. The length of time they are retained differs exceedingly for various subjects, for various states of health, and for various food. The average quantity is about 6 or 8 ounces in the twenty-four hours.

The fæces consist of the undigested or chemically modified residuum of the food mixed with certain excretory matters thrust out by the body itself, as bile, &c. Its composition is about one part of solid to rather less than three parts of water. The special excrementitious constituents, not derivable from the food, nor from the ordinary secretions, as bile, &c., are excretin, excretolcic acid, stercobilin, giving the usual colour, and indol giving the characteristic odour.

FAEN'ZA (the ancient *Faventia*), an episcopal town of Italy, in the province of Ravenna, is situated in a well-cultivated plain watered by the Lamone, 20 miles S.W. from Ravenna. The Zanelli Canal connects Faenza with the Po di Primaro, or southernmost branch of the Po. Faenza is a well-built town, with 36,042 inhabitants. The streets are regular; there are a fine market-place surrounded by arcades, many palaces, churches rich in paintings, convents, an hospital, a lunatic asylum, a fine bridge on the Lamone, a theatre, and a lyceum. The town-hall was formerly the palace of the Manfredi family, and was the scene of the murder of Galeotto Manfredi by his wife. There are several manufactories of a kind of coloured and glazed earthenware, which is called Majolica in Italy and Faience in France, and which, before the manufacture of china or porcelain became established in Europe, was in greater repute than it is at present. There are also manufactories for spinning and weaving silk, and some paper mills. There are thermal and saline springs in the vicinity. Faventia was a town of the Boii, and afterwards a municipium under the Romans. Near Faventia Sulla defeated the Consul Carbo and drove him out of Italy.

FAES, PETER VAN DER. See LELY.

FAF'NIR, in the Norse mythology of the Volsunga Saga, is a gigantic worm or serpent, guarding splendid treasure, and slain by the hero Sigurd, who desired to possess the treasure. By those who adopt the "solar theory" as explaining these ancient myths, the treasure is explained to be the sunlight, and Fafnir is the winter cloud which hides them, or the darkness which swallows them up.

FAGGING is the name given to a practice peculiar to the public schools of England—that is to say, Eton, Harrow, Rugby, Westminster, and Winchester. Its origin is lost in antiquity. Each boy of the upper forms has the privilege of making one or two boys of the lower forms or classes perform for him such tasks as carrying messages, preparing breakfast, and lighting fires, which services are called fagging. In addition to this duty to a special master, the lower boys or fags have also to give attendance at all the games of their seniors. The propriety of fagging has been much discussed, and many arguments advanced in support and condemnation of it; but of late years the practice has been gradually falling into desuetude.

FAHL'ERZ or **FAHL ORE** is a name used by miners for the mineral *tetrahedrite;* it is also sometimes called *gray copper ore.* The mineral is exceedingly variable; its hardness ranges from 3 to 4·5, its specific gravity from 4·5 to 5; in composition it is normally sulphide of copper and antimony, or sulphantimonite of copper ($4CuS + Sb_2S_3$), but the antimony is sometimes replaced by more or less arsenic or bismuth, and the copper by iron, zinc, silver or mercury—the amounts of the latter metals present forming the grounds for dividing the mineral into different varieties. Some of the argentiferous varieties are sufficiently rich to be worked for silver. Saxon specimens (from Frieberg) have been known to contain over 30 per cent. of silver. The ore is found in tolerable abundance in Cornwall, Hungary, Tyrol, California, Mexico, and Bolivia; the argentiferous varieties in Saxony, the Harz Mountains, Chili, and in the state of Arkansas. The name *tetrahedrite* was given to the mineral from the fact that the predominant crystal form is the tetrahedron (of the cubic system). Fahl is a German term for the ore, and the word means *pale* or *light coloured.*

FAHLUN. See FALUN.

FAHR'ENHEIT, GABRIEL DANIEL, inventor of the thermometer hitherto generally used in England, but now giving way gradually to the more logically divided "centigrade," was born at Dantzic in 1686. He travelled in Germany and England, and was elected a fellow of the Royal Society in the latter country in 1724. He died in Holland, where he finally settled, in 1736. In 1720 he hit on the happy idea of using mercury instead of spirits of wine in the thermometer, to the great improvement of the accuracy of that instrument. He mixed ice and salt to get an intense cold, and took this as his zero-point—the freezing-point of water is 32 of his degrees above this, and the boiling-point 212. There are therefore 180° between the two. The same space is divided into 100° by the centigrade scale of Celsius, therefore 9° Fahrenheit equal 5° centigrade. In converting from one scale to the other the 32° Fahrenheit below freezing-point must be added or deducted as the case requires.

Fahrenheit also constructed a barometer useful for measuring high pressures, as the height of the column of mercury is much reduced. The instrument consists of a long tube bent several times, the lower curves being filled with mercury and the higher with coloured water. The pressure is read by the sum of the differences of level of

the mercury in the lower curves, diminished by the sum of the differences of level of the water in the upper curves.

FAIENCE or **FAYENCE** is a variety of painted and glazed pottery made originally at Faenza in Italy, whence its name. The enamel was particularly white and fine, and the colouring soft and well harmonized. The drawing is usually very good. The fine Henri II. *Fayence*, of which so little remains, is mentioned in CERAMIC ART. Faience was often used as almost synonymous with enamelled pottery in general. See MAJOLICA.

FAINÉANTS, ROIS. The later kings of the great Frank Merwing (Merovingian) dynasty received this name of "do-nothing kings" (*fais néant*), as they had completely sunk under the domination of the mayors of the palace. Clovis II. and ten successors usually receive this contemptuous designation. The *rois fainéants* were superseded in 750 by Pepin, mayor of the palace, seizing the title of king as well as the power. The dynasty of the Karlings (Carlovingian), so called from Pepin's son Karl, afterwards the Emperor Charles the Great, followed the Merwings; and they in turn were followed by the Capets in 987. But it is worth remark that Louis V., the last Karling, received the same nickname of *roi fainéant* when Hugh the Great, count of Paris (the first Capet), ruled in his puppet's name, as the first Karling had done in that of Childeric III., last of the Merwings.

FAINTING or **SYNCOPE** arises from a sudden failure of the action of the heart. This may be brought about by causes which act directly upon that organ, such as organic disease, compression of the chest, excessive heat, &c.; by causes acting through the nervous system, such as the emotions of fear, joy, grief, or the influence of severe pain; and from the condition of the blood, as in anæmia, or its loss in hæmorrhage. The indications of a fainting fit to a bystander are usually the appearance of a sudden pallor, the loss of power over the limbs, a rolling of the eyes, while the eyelids tremble or close, the face becomes pale and still, the pulse fails, becoming weak, small, and frequent, the respiration is irregular and feeble, and there is a loss of consciousness. The patient is generally at the same time personally conscious of a feeling of faintness, followed by sickness or giddiness; there comes an indistinctness over the sight, hearing fails, or there is a "drumming" in the ear, and everything seems as if swimming or going round, while consciousness fades away.

It is easy as a rule to distinguish an ordinary fainting fit from an attack of epilepsy of the severer kind, but the symptoms of epileptic vertigo, or *petit mal*, are often very similar. The latter, however, is usually more of a spasmodic character, and the loss of consciousness is sudden and distinctly marked. In hysteric seizures the patient, instead of becoming still and pulseless, usually laughs, cries, or screams, and has a full strong pulse.

Fainting is most common in young adults, especially young females. Its occurrence is favoured by anything that tends to ill health, more especially anæmia or poorness of blood. A fainting fit may be induced by fatigue, want of food, any sudden strong impression on the nervous system, or the effects of a hot close atmosphere. In some constitutions very little serves to bring about fainting, and there are some persons to whom the sight of blood, of a noxious or disgusting insect, or even the hearing the account of an accident, operation, &c., will bring on an attack.

In the treatment of fainting it is necessary to remove any exciting cause where this is possible, and to endeavour to restore the action of the heart. If the patient has fallen the body and limbs should be straightened out, the head should be laid low, and an abundance of cool fresh air should be admitted. Any tight article of dress should be loosened so as to remove pressure from the neck, chest, and abdomen. A little cold water may be sprinkled upon the face, or a current of cold air may be directed upon it by fanning, &c. Smelling salts, sal-volatile, camphor, or any strong perfume may be applied to the nostrils, and this will often of itself restore consciousness. Where these measures fail friction of the body and limbs may be resorted to, or artificial respiration may be tried. As soon as consciousness returns and the patient is able to swallow, a little cordial stimulant should be administered, such as alcohol in the form of brandy or other spirit (either neat or mixed with water), sal-volatile, or chloric ether. The patient should not too hastily assume the erect posture or a return of the fit may be induced, and rest, and if possible some stimulant or nourishment, should be taken before any active exertion is undergone.

Where fainting occurs without any perceptible cause a medical examination should be sought, as it is sometimes the first indication of serious disease. Where it arises from debility attention must be directed towards the improvement of the general health.

FAIOUM' or **FAYOUM'**, a province of Egypt to the west of the Libyan ridge, which bounds the valley of the Nile on the west. About 12 miles N.W. of Benisouef there is a depression in the ridge about 6 miles in length, which leads to the plain of Faioum. This plain is of a circular form, about 40 miles from E. to W. and about 30 from N. to S. The northern and north-western part of it is occupied by the lake called Birket el Keroun. A range of naked rocks bounds the lake to the north, and joins towards the east the Libyan ridge, which skirts the valley of the Nile. To the west and south the plain is bounded by lower hills, which divide it from the Libyan Desert. All the part west of Nezleh is arid and sandy, and inhabited only by a few nomad Arabs. It is calculated that the land susceptible of cultivation in the Faioum is about 450 square miles. The cultivated part is superior in fertility to every other province of Egypt, and this advantage it owes to the system of irrigation by small rills which are fed from the canals. In addition to corn, cotton, and the other cultivated plants, it produces in abundance apricots, figs, grapes, olives, and other fruit trees, which thrive here better than in the valley of the Nile. A vast quantity of roses also grow in the Faioum, and this district is celebrated for making rose-water, which is sold at Cairo and all over Egypt.

South of the Faioum there is an opening through the hills into a smaller circular plain with a small lake called Birket el Garaq, which has one or two hamlets on its banks. A small stream from the Bahr Yussouf runs into it.

There are numerous ancient ruins in Faioum, among others some that are supposed to be those of the famous labyrinth described by Herodotus (lib. ii. s. 148). Upon the banks of a lake that is said to be the ancient Lake Mœris stands the capital of the province, Medinet-el-Faioum, on the site of the ancient capital, called successively Crocodilopolis and Arsinoe.

FAIR, an annual or fixed meeting of buyers and sellers (from the Latin *feriæ*, public festivals or holidays). Anciently, before any flourishing towns were established and the necessaries or ornaments of life, from the convenience of communication and the increase of provincial towns, could be procured in various places, goods and commodities of every kind were chiefly sold at fairs, to which, as to one universal mart, the people resorted periodically, and supplied most of their wants for the ensuing year. Warton, in his "History of English Poetry," has given us a curious account of that of St. Giles Hill or Down, near Winchester. As late as 1512, as we learn from the Northumberland Household Book, fairs still continued to be the principal marts for purchasing necessaries in large quantities, which are now supplied by the numerous trading towns.

In Europe fairs are generally held for the sale of goods in which there is a frequent change of fashion, for the sale of cattle, or solely for pleasure. Provisions are seldom sold, except in places on the outskirts of civilization. The greatest fairs in the world are the Easter and Michaelmas fairs at Leipzig and those of Frankfurt-on-the-Main in Germany. Next in extent and duration comes the fair of St. Peter and St. Paul at Nijni Novgorod in Russia, which is frequented by about 200,000 buyers and sellers from different parts of Europe and of Northern and Central Asia; and it is said that commodities to the amount of £4,000,000 are annually disposed of.

Great fairs are also periodically held at Brunswick in Germany, Pesth in Hungary, Beaucaire and Lyons in France, Tanta in Upper Egypt, Mecca in Arabia, and Hurdwar in India.

The fairs in Britain are gradually decreasing in number and importance, those really of use being chiefly for the sale of cattle and of the annual produce of pastoral districts. The prevalence of good roads, railways, the improved communication between towns and villages, the increase of populous towns, and other results of advanced civilization, have rendered them, in a mercantile sense, unnecessary; and even the pleasure fairs are fast becoming extinct.

FAIRFAX, SIR THOMAS (afterwards Lord Fairfax), general of the Parliamentary army in England during the Civil War in the reign of Charles I., was the son of Ferdinando, lord Fairfax, and was born at Denton, near Leeds. He went to St. John's College, Cambridge; but being inclined to military employment, as soon as he left college enlisted in the army of Lord Vere, and served in Holland. In 1642, when the Civil War broke out, he accepted a commission under his father, who was general of the Parliamentary forces in the north. Fairfax soon distinguished himself. He raised the siege of Nantwich, in Cheshire, defeated the forces under Colonel Bellasis, governor of York, proceeded into Northumberland, and thus enabled the Scots to march southwards, and in conjunction with them fought the memorable battle of Marston Moor (2nd July, 1644). Before Helmsley Castle, which he afterwards besieged, he received a wound in his shoulder that caused his life to be despaired of. When the Earl of Essex ceased to be Parliamentary general, Fairfax was appointed his successor (January, 1644–45), and Cromwell his lieutenant-general. The decisive battle of Naseby was fought 14th June, after which Fairfax possessed himself of Bath, Bristol, and other important posts in Somersetshire. When he returned to London, in November, he was publicly thanked for his services, and received from the Parliament a jewel of great value, set with diamonds, together with a considerable grant of money. The payment of the £200,000 to the Scottish army, in consideration of which they delivered up the king, was intrusted to Fairfax, who marched northward for this purpose.

In 1647 he was made Constable of the Tower, and in the following year, at his father's death, he inherited his titles and estates. In December he marched to London, menaced the Parliament, and quartered himself in the palace of Whitehall. He was named one of the king's judges, but refused to act; and he was voted one of the new council of state (February, 1648–49), but refused to subscribe the test. He continued in command of the army until June, 1650, when upon the Scots declaring for the king he declined marching against them, and consequently resigned his commission. He now remained in comparative retirement until his death, in 1671.

FAIRFORD, a market-town of England, in the county of and 23 miles E.S.E. from Gloucester, and 95 miles from London by the Great Western Railway, is situated on the banks of the Calne. The town consists of two streets neatly and regularly built. It has a free school, a lunatic asylum, and other charities. Fairford is celebrated for the beauty of its church, which was built in the reign of Henry VII. It has twenty-eight windows of painted glass, being the most valuable and unique examples of the art of glass painting to be found in England. The vicissitudes of three centuries have left some of them rather mutilated, but on the whole they are in wonderful preservation. Population of the parish, 1525.

FAIRIES, a race of supernatural beings created in the lively imaginations of our ancestors. The subject is a peculiarly interesting one, not only for the insight its study affords into the thought and knowledge of past times, but because it has given rise to some of the most beautiful and graceful literature in existence. The belief in fairies is peculiar to Europe, and is one branch of the great Teutonic conception of a whole people of elves filling earth and air, but usually invisible to mortals. [See ELF.] The word fairy is simply the French equivalent for elf-land. In rocky barren countries, or those subject to mists and fogs, the fairies are found to be beings rather opposed to man, leading him to death, carrying away his children, and substituting fairies to plague the unfortunate parents; while in gentler countries, such as England, they take the form of tiny beings of both sexes in human shape, fabled to haunt houses in companies, to reward cleanliness, to dance and revel in meadows in the night-time, and to play a thousand pranks. Both sexes are represented generally as clothed in green, and certain circular appearances occasionally seen in pastures and on heaths are supposed to be the traces of their tiny feet, which remain visible on the grass for a long time after their dances; these are still called FAIRY RINGS or circles.

The reader who would look further into fairy mythology may consult Sir Walter Scott's "Essay on the Fairy Superstition," in the "Minstrelsy of the Scottish Border;" Keightley's "Fairy Mythology" (1850); "Hazlitt's Fairy Tales, &c., illustrating Shakspeare" (London, 1875); and "Ritson's Fairy Tales, with Dissertation on Pigmies," edited by Hazlitt (London, 1875).

FAIRY RINGS are bare circles with a circumference of dark-green grass, frequently to be seen in pasture-land. They are due to the growth of a mushroom-like fungus (*Agaricus orcades*, &c.), the spawn of which spreads from its original position in a circle all round, killing the grass by absorbing all the nourishment in itself. The decay of the agaric forms a good manure, so that the ground upon which it falls produces green and vigorous grass, strongly contrasting with the bare circle. The spread of the spawn may go on for many years, so that fairy rings may be of very ancient date, and may be visible on a hill-side from a considerable distance. In former times the popular superstition was that these rings were formed by fairies' dancing. In 1675 a paper was read before the Royal Society ascribing these rings to electricity, and another in 1807, by Dr. Wollaston, propounding "chemical causes," a view supported by Professor Way at the British Association in 1846. De Candolle proposed an "excretory theory;" but none of these were considered satisfactory. From 1851 up to the present time Messrs. Lawes, Gilbert, and Warrington have contributed occasional papers to the *Journal of the Royal Agricultural Society*, which have led to the general adoption of the "nitrogen theory." The fairy-ring fungi contain nitrogenous compounds to the amount of one-third of their dry substance, the ash being rich in potash and phosphoric acid. The source of nitrogen in the fungi was at first supposed to be the air, but it is now established satisfactorily to be the soil. Experiments were made at Rothamsted, and samples of soil were taken within a fairy ring, immediately upon it, and outside. The analyses of these showed that the lowest percentage of nitrogen occurred within the ring, a higher percentage under the ring, and a higher still outside it.

FAITH, a term which is used in the New Testament with various meanings. It is most frequently employed to denote the personal trust of the soul in God and in Christ for the blessings of salvation, as in Rom. iii. 28. In some passages it means truthfulness or fidelity; in this sense it is applied to God in Rom. iii. 3, and is included among the graces which are to be obtained and cherished by those who are already Christians, as in Gal. v. 22; Titus ii. 10. In one passage at least it means proof or evidence, the words "given assurance" in the Authorized Version for it in Acts xvii. 31 being literally, as in the margin, "offered faith," and in another the conscientious conviction of duty (Rom. xiv. 23). In a more general sense it is applied to the gospel itself (Gal. i. 23; Jude 3); and in the familiar exposition and illustration given in Heb. xi. it signifies the practical apprehension of spiritual and divine things which underlies all true religion—the grace in which belief, trust, and obedience are all combined.

In theology also the word is used in various senses, and metaphysical divines speak of miracle-working faith, a grace peculiar to the early church; of temporary faith, such as that symbolized by the seed sown in stony places or among thorns; historical faith, which accepts the sacred writings on suitable evidence; and saving faith, the gift of the Holy Spirit. It is also defined according to the distinctive peculiarities of different schools of theology, though nearly all seek to reconcile or to defend their definition by the words of Scripture. Thus in a widely used Roman Catholic catechism, faith is described as being "a supernatural virtue, by which we firmly believe all that God teaches us by his church, and we submit our understanding to this teaching, because God cannot deceive us," and the first sin against faith is declared to be a refusal to believe the teachings of the church. In many Protestant manuals a similar definition may be formed with the word "Bible" instead of "church," as in the following:—"Faith denotes the credit we give to the declarations of God, or to the evidence of the facts or propositions presented to us in the Bible." Again, while among Evangelicals the chief stress is laid upon the element of personal trust upon Christ as the Saviour, liberal Christians and Unitarians dwell more upon that aspect of faith which regards it as a spiritual apprehension of divine things.

FAIZABAD′, a division, district, and town of British India, in Oudh, under the jurisdiction of the lieutenant-governor of the North-west Provinces. The division (which comprises the three districts of Faizabad, Gonda, and Bahraich) has an area of 7118 square miles, and a population of 3,000,000. The district (which carries on an important trade with the cities of the north-west) has an area of 1649 square miles, and a population of 1,000,000. The town of Faizabad, which is the administrative headquarters of both the division and the district, is situated on the left bank of the river Gogra, 78 miles east of Lucknow, and has a very active trade in the agricultural produce of the district. It is a large station on the Oudh and Rohilkhand Railway, and also a military cantonment. The great majority of the inhabitants of Faizabad are Hindus.

FA′KENHAM, distinguished from other places of the same name as Fakenham Lancaster, is a market-town of England, in the county of Norfolk, 24 miles N.W. from Norwich, and 139½ from London by the Great Eastern Railway. It is situated on a pleasant declivity near the river Wensum, which is spanned by a handsome bridge of three arches. The church is handsome and commodious, and was thoroughly restored in 1864. There is an ancient market-cross. A corn-market, held on Thursday, is one of the largest in the county; and there are some large flour mills, a brewery, and malt-houses in the town. Population, 2756.

FAKIR′, an Arabic word meaning poor, which is applied to the ascetics of several parts of the Eastern world. In this sense it is synonymous with the Persian word *dervish*. The word fakir is chiefly used in Hindustan.

FALAISE, a town of France, in the department of Calvados, 20 miles S.E. from Caen, on the Ante, a feeder of the Dive. It stands on very uneven ground, and is divided into three distinct parts—the suburb of Guibray, which is built on the top of a hill; the town itself, which occupies the slope; and the faubourgs of Val d'Ante and St. Laurent, which are situated on the low ground. The churches of St. Laurent, St. Gervais, and Guibray, the hospital, the public library, and above all the ancient castle, which contains the apartment wherein the Conqueror was born in 1027, are the most remarkable buildings in the town. The castle is a grand and picturesque ruin, occupying a commanding position at the extremity of the town, where the platform is cut into a narrow promontory by gullies which isolate it on three sides, rendering it a place of great strength. From its walls there is a fine view into the Val d'Ante, so called from the small stream which runs through it, crowded with mills and tanneries. It was while gazing upon this scene, according to the tradition, that Duke Robert, the father of the Conqueror, first espied Arlette, the tanner's fair daughter, washing in the stream, and became at one so smitten with her charms, that he made her his mistress, and continued faithful to her until death, after which she became the wife of Herlwin of Conteville and the mother of Odo, the fighting bishop of Bayeux. Near it stands a very fine monument of William the Conqueror, which, though commenced in 1851, was only finished in 1875. Falaise has tribunals of first instance and of commerce, a college, and a population of 7983. Cotton, hosiery, bobbinet, and coarse calicoes are manufactured; there are also tanyards, paper mills, dye-houses, and bleaching establishments. Falaise derives its name from its situation on a rock bordering on a precipice or *falaise*. In the suburb of Guibray some famous fairs are held, which are said to have been established by William the Conqueror.

FALCON, a name with a very ill-defined meaning. The largest and most important family of the order Accipitres, or birds of prey, is the FALCONIDÆ, which are often popularly called falcons or hawks. This large family, which contains nearly every bird of prey except vultures and owls, is necessarily split up into a number of smaller groups or subfamilies, one of which is the Falconinæ, containing the genus Falco and several allied genera. This subfamily contains the true or noble falcons, as they were formerly called, from the circumstance that nearly all the species of birds employed in the favourite ancient diversion of hawking or FALCONRY belonged to this group. By falconers the name falcon is given technically only to the female of the birds employed in this sport, as being larger and more powerful than the male; generally, indeed, it was exclusively applied to the female of a single species, the Peregrine.

The true falcons are distinguished by having the margins of the upper mandible not merely sinuated, but armed with an acute tooth on each side not far from the apex. Their wings are pointed, and the second feather in the wing is the longest; hence they are known as long-winged hawks or falcons. The other species of the family Falconidæ were denominated *ignoble* birds of prey, partly from their deficiency of courage as compared with the true falcons, and partly from the intractability displayed by most of them, which rendered them unfit for the purposes of the falconer. The true falcons well deserve the epithet noble thus applied to them. There is an elegance in their port and a boldness in their aspect which distinguish them at a glance from most other birds of prey, while their astonishing power of flight and great muscular strength render them the types of predaceous birds.

The species of falcons are numerous and well distributed. The falcon *par excellence*, the PEREGRINE, has an almost world-wide distribution. It was formerly abundant in Great Britain, but is now fast diminishing in numbers. Other British falcons are the GYRFALCON,

Peregrine Falcon (*Falco peregrinus*).

MERLIN, HOBBY, KESTREL, each the type of a little group with representatives from foreign climes.

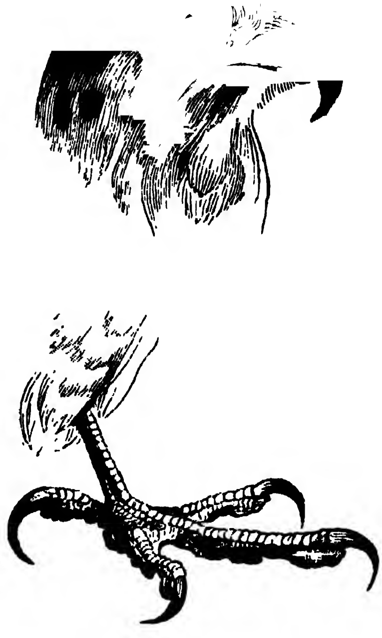
FALCONER, WILLIAM, was born at Edinburgh in 1732. When young he served on board a merchantman, and was afterwards second mate of a vessel in the Levant trade, which was shipwrecked on the coast of Attica, himself with two others being the only survivors. This event formed the groundwork of the famous "Shipwreck," which poem he published in 1762. The notice which the poem received enabled him to enter the navy as a midshipman in the *Royal George*. After some other appointments, he became purser to the *Aurora* frigate, and was lost in her during the outward voyage to India in the winter of 1769.

FALCON'IDÆ is a family of birds of prey (ACCIPITRES). In this family the destructive power is at its maximum. We find in the birds composing it natural instruments for striking, trussing, and rending their prey, combined with a power of flight and strength of limbs equivalent to the necessities of the case, whether the prey be aerial or terrestrial. Of these natural weapons, the head and foot of the peregrine falcon afford an apt illustration.

The bill is stout, hard, hooked, with the upper mandible often toothed and furnished at the base with a cere, in which the nostrils are pierced. The eyes are overshadowed by protecting brows; the head and neck are clothed with feathers; the toes are large and strong, and armed with powerful hooked claws, which, though not retractile, as in the beasts of prey [see FELIDÆ], are nevertheless capable of being elevated at pleasure, so that their sharp points may be kept unworn and unblunted. From this circumstance the claws of falcons, when sitting on stones or large branches of trees, have often a cramped appearance. The power of flight is very great; the pectoral muscles are extremely voluminous, and the keel of the sternum is singularly deep; the shoulders are kept wide apart, and supported by strong clavicles, and a *furculum*, or merrythought, of great breadth and stoutness, and of a boldly arched form. The wings are ample, generally long, and the quill-feathers firm and rigid; the tail is broad, and its feathers resemble in character the quill-feathers of the wings.

Of all the senses that of sight is the most acute. In no genus of birds are the powers of vision more wonderful than in the falcons. Elevating themselves, as they occasionally do, into the highest regions, it is necessary that they should perceive objects at very different distances, and in various directions; added to which, the rapidity of their flight renders extreme keenness of eye essential.

In the habits and mode of life of the Falconidæ, there is a much greater variety than is observable in the vul-



Head and Foot of Peregrine Falcon.

tures. Some of them feed almost exclusively upon birds and mammals; others upon snakes, frogs, and other reptiles. Others, again, are fishers by profession; while a considerable number, especially of the smaller species,

The Kite (*Milvus ictinus*).

derive a great portion of their nourishment from insects. A few are habitual carrion-eaters. Their modes of catching prey are also greatly diversified. Some hover in the air, or sail slowly along until their victim appears in sight,

when they dart down upon it with the rapidity of lightning; some pursue their prey with the greatest pertinacity, until they get an opportunity of seizing it with their murderous talons; while others haunt woods and thickets, and appear to lie in waiting for their food. The nests, usually very rude, are placed among rocks or in tall trees, in almost inaccessible situations. The eggs are few in number, from two to five, which are almost always of a white colour, spotted with reddish-brown. The females are generally larger than the males, but inferior to them in intensity of colour; and the young birds pass through several changes of plumage before attaining their adult dress.

The Falconidæ are a very large and widely distributed family. They may be divided into the following subfamilies—Polyborinæ (CARACARAS), Accipitrinæ (HAWKS), Buteoninæ (BUZZARDS), Aquilinæ (EAGLES), Falconinæ (FALCONS), Pandioninæ (OSPREYS). Some of the genera included in the above subfamilies are noticed separately, as, GOSHAWK, HARPY, HONEY-BUZZARD, KESTREL, KITE, &c.

FALCONRY or **HAWKING**, the art of training and flying hawks to take other birds. Julius Firmicus, who lived in the middle of the fourth century, is the first Latin writer who speaks of falconers and the art of teaching one species of bird to fly at and catch another. The art, however, had been, in all probability, practised in the East from remote ages, whence it certainly came to Europe.

From the Heptarchy to the time of Charles II. falconry was the principal amusement of our ancestors in England. A person of rank scarcely stirred out without a hawk upon his wrist, which, in old illuminations and upon ancient seals, is the criterion of nobility. Harold, afterwards king of England, is thus represented in the Bayeux tapestry, when visiting the court of William, duke of Normandy.

Florence of Worcester (4to edition, 1592, p. 310) states that King Alfred had his falconers among the persons whom he encouraged for their skill in different professions; and a metrical treatise on the art of falconry, still extant, is ascribed to King Edward the Confessor.

In Domesday Book the practice of falconry is illustrated by numerous entries. In several places we find a sum, no less than ten pounds, made the optional payment instead of finding a hawk (Domesd., tom. i. folio 134, b. 172, 230); and once at Worcester (tom i. 172) a Norway hawk is specified. Eyries, or places destined for the breeding or training of hawks, are entered in the survey in Buckinghamshire, Gloucestershire, Worcestershire, Herefordshire, Shropshire, and, more frequently than in other counties, in Cheshire, as well as among the lands between the Ribble and the Mersey.

Nor were hawks less prized at subsequent periods. According to Maddox ("Hist. Excheq.," i. 273), in the 14 Henry II., Walter Cnot, one of the king's tenants, rendered his rent at the exchequer in three hawks and three gerfalcons. King John had also his hawks; and upon the Patent Roll of the 34 Henry III. a copy occurs of the letter which the king sent in that year to the King of Norway for hawks. Bray, in the "History of Surrey," relates a curious anecdote of Henry III.'s anger with one Roger Belet, who by reason of something he had done or omitted about a spar-hawk, was disseised of all his lands and 40*s.* rent in Bagshot. In the 34 Edward III. it was made felony to steal a hawk; to take its eggs, even in a person's own ground, was punishable with imprisonment for a year and a day, besides a fine at the king's pleasure. In Queen Elizabeth's reign the imprisonment was reduced to three months; but the offender was to find security for his good behaviour for seven years, or lie in prison till he did.

Edward III., according to Froissart, had with him in his army, when he invaded France, thirty falconers on horseback, who had charge of his hawks; and every day he either hunted or went to the river for the purpose of hawking, as his fancy inclined him. Queen Elizabeth is represented enjoying this sport in a woodcut in Turbervile's "Falconry," published in 1575; and it was the favourite amusement of King James I.

The species of falcon to be used by each rank was strictly defined:—A gerfalcon (gero-falcone, *i.e.* a falcon which flies in circles—gyrfalcon is also used) for a king, a peregrine falcon for an earl, a merlin for a lady, a goshawk for a yeoman, a kestrel for a knave, and so on. The training of falcons, which commences when they are very young, is a difficult process, requiring much skill and discretion; consequently in olden times the office of falconer was a post of considerable importance. In actual sport the falcon, with its hood on, is carried into the field on the left wrist of the hawker, to which it is attached by a leash. The quarry or prey having been sighted, the hawk is unhooded and cast off. After striking the quarry it is either allowed to feed on it, or is attracted from it by means of a lure. In England the heron was always the favourite object of pursuit, and, unless badly injured by the hawks, the captured heron was again set at liberty after its wounds had been dressed, and a ring, with the name of the captor engraved on it, attached to its leg.

Hawking is occasionally practised in modern times, and at Valkenswaard, in the Netherlands, the trade of hawk-catching for falconry still survives from past generations. The birds no longer fetch the fancy prices of which we read in old days, but there is still a sort of demand for the supply, and the capture of the birds, though not so dangerous as that of the sea-cliff peregrines of Norway and North Britain, is an arduous task. The snarer sits in a hut within range of his snares, which he commands by strings, like those of pigeon-traps at Hurlingham or the Gun Club. To keep him informed when a hawk is on the wing in his vicinity he has two shrikes, which espy a passing hawk long before human eye can discern her, and betray her presence by their gestures. Then the trapper is on the alert, and when the hawk appears lets fly a tethered pigeon for her to kill. While the hawk is intent on her prey the trapper snares her. The time for this operation is the fall of the year, when hawks are migrating.

The earliest printed treatise on hawking in English is the "Boke of St. Albans" (folio, 1481), ascribed to Juliana Berners, abbess of Sopwell, and recently republished in facsimile. There are numerous other and curious treatises upon falconry both in French and English. A valuable work published on the subject is "Falconry, its Claims and Practice," by Freeman and Salvin (London, 1859).

FALD-STOOL (folding-stool) is the small desk used for saying the Litany. It was also the name of a folding seat, somewhat on the principle of our camp stool, used in the Saxon cathedral service.

FALER'NIAN, a species of wine frequently mentioned by the Roman poets:—

> "Et amicus Aulon
> Fertili Baccho minimum Falernis
> Invidet uvis."—*Hor.* "*Od.*" II. vi. 18.

It was so called from Falernum, a mountain of Campania, where it was produced, and was considered one of the best wines in Italy. There were three kinds, the sweet, the fine, and the rough; that called Faustianum was the best.

FALIE'RO, MARINO, Doge of Venice (1354–55), made memorable his year of office by a conspiracy against the oligarchical constitution which was undermining the greatness of the state. He had done the state service in almost every capacity, had performed a brilliant feat of arms at Zara, was of an old senatorial family, was the third doge of his name, and was seventy years old. Legend has also introduced an insult offered to his young wife by a patrician, but with slender authority. As Byron has adopted it in his famous play it is now universally accredited.

The story of Faliero's conspiracy comes to us only from his enemies, and we may be sure we have not the true tale. Judging from his noble life it seems more likely that he meditated a restoration to the ancient free democratic constitution under which the state had achieved greatness. His place among the portraits of the doges in the palace at Venice is filled by the painting of a black veil and the Latin inscription, "This is the place of Marino Faliero, beheaded for treason."

FAL'KIRK, a prosperous market-town and municipal and parliamentary burgh of Scotland, in the county of and 11 miles S.E. from Stirling, and 425 from London by the North British Railway, consisting of a principal street extending along the road from Edinburgh to Stirling, with others branching off from it or running parallel to it. Falkirk stands on an elevation with a gentle declivity on each side. It contains many handsome houses, and is well supplied with water. The town possesses a very handsome court-house, a modern church, which stands on the site of one of the eleventh century (the churchyard containing the graves of two of Wallace's companions), several chapels; grammar, science and art, Roman Catholic, and other schools; public library, Livingstone's Hospital, banks, town-hall, constructed from the corn exchange, Catholic institute, distilleries, and flour-mills. The town is chiefly indebted for its prosperity to an extensive inland trade, and to the Carron and Falkirk Iron-works, chemical manufactories, fire-brick and tile works, and to some very extensive collieries in the neighbourhood. It is also famous for its cattle trysts or fairs, which are the largest in Scotland. They are held near the neighbouring village of Stenhousemuir, in August, September, October, and November. A great number of cattle and sheep are brought from the Highlands and the Western Isles, and are chiefly disposed of to buyers for the English markets. The fair in October is the largest, as the breeders must then part with all the stock which they do not intend to keep through the winter. The town, divided into four wards, is governed by a provost, three bailies, a treasurer, a town-clerk, and nine councillors. Population of the burgh, 13,170; of the parish, 25,148. The parliamentary district of Falkirk, which returns one member, consists of Airdrie, Falkirk, Hamilton, Lanark, and Linlithgow, and has an aggregate population of 49,351. The total number of electors in the whole district is 5800. The town is situated at the south-west extremity of the fertile tract called the Carse of Falkirk. Near it, in 1288, Sir William Wallace made his masterly retreat from the battle of Falkirk, in which he had been completely defeated by a very superior force of English under Edward I. The Scottish loss, it is said, amounted to 15,000 men, including Sir John Graham and Sir John Stewart. In 1746 the royal troops under General Hawley were defeated near this place by Prince Charles Edward. The Gaelic name for Falkirk is *Eaglais-bhreac*, or the Speckled kirk. Camelon village, in the vicinity, was once a Roman station; and near this the famous Roman wall began, commonly called Graham's Dyke, which was erected A.D. 140, in the reign of the Emperor Antoninus Pius, and extended across the island from the Carron to the Clyde.

FALK'LAND, a royal and municipal burgh of Scotland, in the county of Fife, at the foot of East Lomond Hill, 25 miles N.N.W. of Edinburgh. The town consists of a single street, with some cross lanes, the houses being in many cases thatched, and of an antique primitive description. Falkland is remarkable only for its having been a royal residence, and for the many historical recollections connected with it. The palace, which was originally a stronghold belonging to the Macduffs, thanes of Fife, was attached to the crown in 1424, on the forfeiture of that ancient house, and became a hunting seat of the Scottish monarchs. It stood on the east of the town; and the present, which is but a fragment of the original building, was erected by James V. This monarch died here in 1542. It was a favourite residence of his grandson, James VI. The last sovereign who visited it was Charles II. in 1650. It was afterwards allowed to fall into decay, but what remained of it has been renovated and is now inhabited. In 1715, after the battle of Sheriffmuir, the famous Rob Roy M'Gregor seized on and garrisoned the palace with a party of the M'Gregors, and successfully laid the burgh and the country in the vicinity under contribution.

It was in the old castle, of which there are now no remains, that the Duke of Rothesay was starved to death, though according to tradition he was preserved for a time by milk conveyed from a woman's breast. Falkland gives the title of viscount to the noble family of Cary, Lord Hunsdon.

FALKLAND ISLANDS, a group of islands in the South Atlantic, situated between 51° and 53° S. lat. and between 57° and 62° W. lon., and consisting of two principal islands, East and West Falkland, with numerous smaller islands. East Falkland is 90 miles long and on an average 40 miles wide; West Falkland is about 80 miles long, with a mean width of about 25 miles. The smaller islands, about 200 in number, vary considerably, from 16 miles in length and 8 in width, to mere islets of half a mile in diameter. The area of the whole is about 5,000,000 acres. The population in 1881 was 1553.

The whole group is deeply indented by sounds, bays, harbours, creeks, and inlets. On West Falkland, and some small islands near it, there are high precipitous cliffs, in a few places exposed to the western seas; but other places are so low that they cannot be seen from the deck of a vessel 5 miles distant. There is a perpetual current from the S.W., which brings driftwood from the south extremity of America. A chain of high hills, called Wickham Heights, runs across West Falkland in a due east and west direction from Port William to Port Sussex on Falkland Sound. The country north of the Wickham Heights has a hilly surface, and at several places these hills rise to some 100 feet above the general level. That portion of the island which lies south of the Wickham Hills may be considered as a level plain, gently declining towards the southern shores. In some parts of the island the bottoms of the valleys are covered by great angular fragments of quartz rock. The most general description of soil is of a very fine, dark, almost black, peaty quality, compact, and from a few inches to 2 feet in depth, lying upon a subsoil of red gravelly clay, where the underlying rocks consist of clay-slate. There is in East Falkland excellent bituminous coal. On the hills the subsoil is chiefly a stiff, dirty white clay. The general aspect of the island is very dreary. The only river of any importance is the San Carlos, about 80 miles in length. The climate is wonderfully healthy, and somewhat resembles that of England, but the summers are not so hot, and the winters not so cold. The wind generally blows hard for eleven months in the year. The thermometer ranges from 26° to 50° in winter and 50° to 75° in summer. Snow sometimes remains on the mountains for weeks together, but ice never exceeds an inch in thickness. Mount Adam is the loftiest peak, 2315 feet.

There are no trees in these islands. There are, however, three different kinds of bushes, which are used as fuel. But the numerous peat moors yield a fuel of a dark black colour, which is of excellent quality. The grasses are long and apparently coarse, but they possess very nourishing qualities. One of them, called *tussac*, has especially attracted the attention of naturalists and graziers. The attempt to introduce our vegetables has generally succeeded; turnips, cabbages, lettuces, radishes, and potatoes grow to perfection. Barley and oats have been cultivated, but the sun is not powerful enough to ripen corn properly.

Wild cattle and wild horses are numerous; wild pigs are

fewer in number. Sheep thrive admirably, and are rapidly increasing in numbers. By means of a judicious crossing with English stock, the weight of the fleece and value of the wool have been doubled. Rabbits are very numerous. Of wild fowl there are swans, geese, ducks, snipe, teals, shags, penguins, rock-hoppers, sand-pipers, gulls, Cape-hens, white-birds, albatrosses, owls, a large kind of carrion-hawks and rooks, with some other smaller species. Off the coasts are seals, black whales, and many kinds of fish.

It is not known whether Amerigo Vespucci discovered these islands; but they were seen by Davis in 1592, by Hawkins in 1594, by Strong in 1690, and by several French navigators early in the next century. In 1764 the French, under the auspices of Bougainville, established a colony on East Falkland, and called it St. Louis; and two years later the British formed a settlement on West Falkland, under Captain Macbride, on the inlet called Port Egmont. The French colony was afterwards given up to the Spaniards, and the English colony was abandoned; but when it was found that the islands formed a convenient halting-place for southern whalers, the republic of Buenos Ayres took possession of them in 1820. England protested against this step in 1829. Meanwhile the government of Buenos Ayres had formed a settlement at Port Louis in 1828, but Great Britain asserted her rights, and the colony was given up to the English in 1837. The islands have since assumed the condition of a regular British colony; and in 1844 a new town was laid out on the southern shore of Stanley Harbour, which is the headquarters of the Falkland Islands colony. It is a land-locked inlet sheltered from every wind, and as vessels can be fitted and repaired more cheaply than at any of the South American ports its importance is likely to increase.

The public revenue and expenditure of the Falkland Islands are each about £5500 per annum. The little commerce of the islands is almost exclusively with England. The imports consist of articles of general consumption, and the exports chiefly of wool, hides, and tallow.

The government is administered by a governor, assisted by an executive and legislative council, both appointed by the crown. The chief objects of the British government in maintaining an establishment on the Falkland Islands, are the advantages which they offer in affording water, fresh meat, and other refreshment to the crews of vessels passing and repassing them in their voyages round Cape Horn. There are no harbour dues or any other similar charges vessels frequently call for repairs and refitting, and for coaling purposes. The occupation of the islands has been the means of a great saving of life and property from shipwreck.

FALKLAND, LUCIUS CARY, VISCOUNT, eldest son of Henry Cary, viscount Falkland, was born in 1610. He was educated first at Trinity College, Dublin, afterwards at St. John's College, Cambridge. After he had left college he pursued his study of the Greek language with great assiduity and success; and his seat at Burford, about 10 miles from Oxford, was often visited by Chillingworth and other learned men of his time. In 1639 he joined the expedition against the Scotch. In 1640 (being only a Scotch peer) he was elected member for Newport, Isle of Wight, in the Parliament which assembled on 13th April, and for the same borough in the Parliament which met on 3rd November in the same year. Charles I. invited him to become one of his Privy Council, and offered to make him secretary of state in the room of Sir Henry Vane. Lord Falkland was disinclined to associate himself with the court party, but was, after much persuasion, prevailed upon to accept the king's offers. His severity of moral principle was ill fitted to harmonize with Charles's duplicity and unconstitutional designs; but, the Civil War having commenced, he adhered to him with inflexible firmness, using every effort to reconcile the contending parties and, though without any military command, attending the king on all occasions of conflict or danger. He fell at the battle of Newbury, 20th September, 1643, having insisted on making one of the first ranks of Lord Byron's cavalry. A monument was erected to his memory near the spot in the year 1879.

FALL RIVER, a seaport of the United States in Massachusetts, situated at the entrance of the Taunton River into Narraganset Bay, 53 miles S.S.W. of Boston. It has a spacious and safe harbour, admitting the largest vessels. The amplest water-power is afforded by the Fall River, which joins the Taunton at its mouth, its length being 2 miles from the Watuppa Lakes, and the descent in the last half mile 140 feet.

The town is well built, and in the vicinity there are valuable granite quarries. The manufacture of cotton goods is its chief industry, but there are also iron foundries, planing mills, bleaching works, and woollen factories. The population in 1880 was 48,961, as compared with 26,766 in 1870.

FAL'LACY is an error arising from some neglect of the correct laws of reasoning. The differences of opinion owing to this cause are so common, that all systems of logic have devoted much attention to investigating the most frequent form in which fallacies appear. In the science of logic it is usual to divide fallacies into two classes—logical and material. The first are those that arise from some error in the mode of expression, and which can be detected by the application of the ascertained laws of reasoning without any special knowledge of the subject matter in question. Breaches of the laws regulating the use of the syllogism, and confusion springing from equivocation of terms, ambiguity of grammar, composition or punctuation, to which may be added doubtfulness of accent and figure of speech, are all fertile in the production of fallacies. The second class of fallacies are those originating in a misconception of the subject itself, and are incapable of being set right by anyone unacquainted with the circumstances attending such subject. They may be divided into seven classes, as follows: the fallacy of arguing from a general rule to a special case without making allowance for accidental circumstances; the fallacy of arguing from a special case to a general rule; the *ignoratio elenchi*, or the substitution for the legitimate contradictory of your opponent of one that greatly resembles it; the *petitio principii*, which is arguing in a circle, or repeating in the conclusion the statement made in the premise, in a different form, or *vice versâ;* the falsely assuming a conclusion from premises with which it has no real connection, or the fallacy of *non sequitur;* the fallacy of assuming a false cause; and the fallacy of many questions.

Modern philosophers, such as J. S. Mill, have given special attention to fallacies arising from neglect of experiment, want of careful observation, and prejudice, and have thus been able to classify many fallacies coming under no distinct head in older systems. No errors have led to more dangerous or ludicrous results than prejudice and neglect of experiment. Of the first the cruel habit of connecting ugliness as exhibited in old women with witchcraft furnishes an example; the second is amusingly illustrated in the anecdote told of the Royal Society, who are said to have been asked to account for the fact that a vessel of water received no addition to its weight on a *live* fish being put into it. Accepting the statement involved in the question as true, the learned men applied their intellects to explain it, but quite forgot to weigh the dish, when they would have found that a fish, whether live or dead, does add to the weight in the usual way. This subject is dealt with in an interesting manner in Professor de Morgan's "Formal Logic," chap xiii., and students may also be referred to Professor Jevons' "Elementary Lessons in Logic," xx. and xxi., and Whately's and Mill's works on logic.

FALLING BODIES, LAWS OF. See ACCELERATED MOTION.

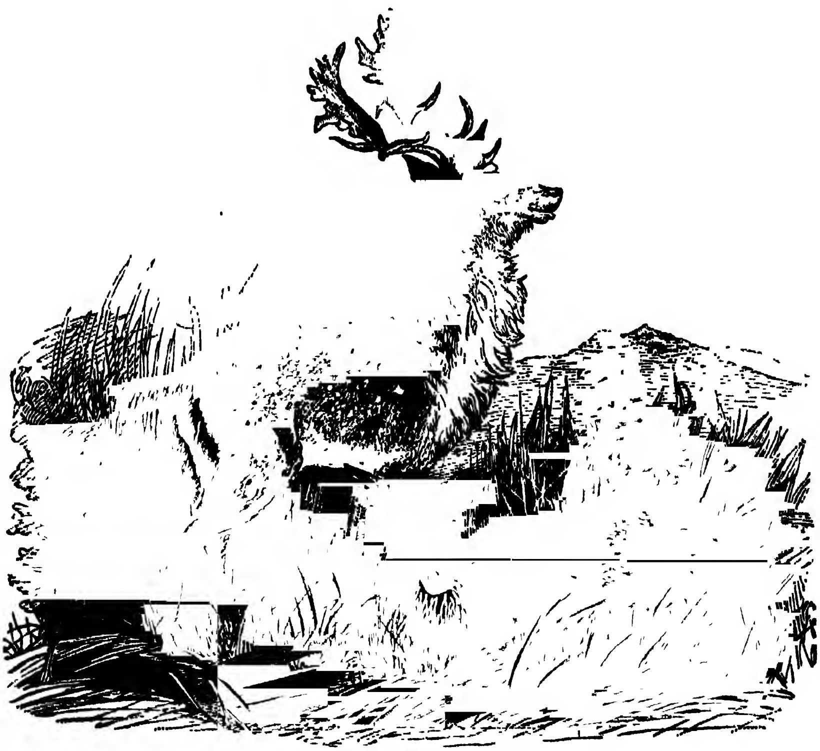
FALLO'PIAN TUBES. The Fallopian tubes, so called from Fallopio, the anatomist who first accurately described them, are tortuous and slender membranous canals, about 3 inches in length, which proceed on each side from the two upper corners of the flattened triangular or pear-shaped body of the uterus. They communicate with its cavity by minute openings capable of admitting a large bristle. As they diverge outwards from their origin they enlarge, and, curving backwards, terminate obliquely in open fringed extremities directed towards the ovaries, which lie below and somewhat behind them. They are included, as are likewise the ovaries, in the duplicature of the peritoneal lining of the abdomen, called the broad ligaments of the uterus, by which that body is itself invested and attached laterally to the cavity of the pelvis. The function of these tubes is to bring the ovum from the ovaries into the womb.

FALLO'PIO (FALLOPIUS), GABRIELE, was born at Modena about the year 1523. He appears at one time to have held an ecclesiastical appointment in the cathedral at Modena, which he resigned to devote himself to more congenial pursuits. Having gratified his curiosity by travelling through the most interesting parts of Europe, he settled for a time as a public teacher of anatomy at Ferrara. He was induced ,by the liberal proffers of the Venetian senate to repair to Padua to take the place of Vesalius.

The studies of Fallopius were by no means confined to one department of natural history. The first botanic garden had been established at Pisa by Cosmo de' Medici in 1548, and was at this time under the management of Cæsalpinus. The second was established two years later at Padua, and the charge of this garden, with the professorial duties annexed to it, was committed to Fallopius.

In addition to his merit as a naturalist and a teacher, he was an excellent and expeditious operator, and, for his time, a good practical surgeon. After a short but brilliant career of eleven years both in practice and as a teacher, he died at Padua in 1562, and was succeeded by his favourite pupil, Fabricius ab Acquapendente.

The only work certainly known to have been revised by himself was a volume entitled "Anatomical Observations." It was first printed in 8vo at Venice, in the year before his death, and has been frequently reprinted. The publication of this work forms an epoch in the science of human anatomy. There is no part of the frame with which the author does not display a masterly acquaintance. Many important parts of it he was the first to describe, if not to observe, and several of them still bear his name. His lectures on pharmacy, surgery, and anatomy were published after his death, in various forms and with very different degrees of fidelity, by his pupils. The best of them were collected and published with his "Observations," in three volumes folio, at Venice in 1584, and have since passed through several editions.



Fallow Deer (*Dama vulgaris*).

FAL'LOW DEER *(Dama vulgaris)* is a DEER well known from being kept in a semi-domesticated state in parks in England. In summer the fur is yellowish-brown and spotted with white, but in winter it becomes blackish-brown; the rump being always more or less whitish, and banded on either side by dark streaks. The tail is dark above and white underneath. The horns are palmated towards the extremities, the flattened expansions being bordered with short "tynes" or digitations. Many varieties occur, differing in the colour and marking of the fur. A uniformly brown variety was introduced into England by James I. from Norway, on account of its hardiness. The fallow deer is a native of the countries lying near the Mediterranean, occurring wild in North Africa, Western

Asia, and Sardinia. It is probable that it ranged over the greater part of Europe in comparatively recent times. The male fallow deer (which is called, when adult, a buck) stands 3 feet high at the shoulder. The female is known as a doe. To the young fallow deer special names are given each year of growth; fawn is the name given to the deer of the first year before the antlers are developed at all. The antlers are not fully developed till the sixth year. The venison of the fallow deer is highly esteemed.

FAL'LOW is a portion of land in which no seed is sown for a whole year, in order that the soil may be left exposed to the influence of the atmosphere, the weeds destroyed by repeated ploughings and harrowings, and the fertility improved at a less expense of manure than it would be if a crop had been raised upon it.

The practice of fallowing land is as old as the Roman Empire. It appears that wherever the Romans extended their conquests and planted colonies, they introduced this mode of restoring land to a certain degree of fertility when exhausted by bearing grain. The attention of agriculturists has in later times been turned to lessen the necessity of fallows, and to substitute some other means of restoring fertility. It is acknowledged by all experienced farmers that manure alone is not sufficient for this purpose. The ground must be tilled and noxious weeds destroyed; and the only efficacious mode of doing so is to stir the ground at the time when their seeds have vegetated, their roots have made shoots, and before any new seed can ripen. But this is exactly the time when corn is usually growing, and when the land cannot be stirred to expose it to the heat of the sun and to dry the roots which are turned up. The only apparent remedy is therefore not to sow it during one summer, and on this principle lands are usually fallowed.

The effect of light and heat on soils varies with the soils themselves, according as they are wet or sandy. Light sandy soils require only cleansing from weeds; and if this can be done without leaving them fallow for a whole summer a great advantage will be obtained. This has been effected completely by the cultivation of turnips and clover, which was first practised in the light soils of Flanders, and afterwards introduced into the similar soils of Norfolk, from whence it has spread all over Great Britain, and is also being adopted pretty generally in Ireland. On light lands the preparation for the turnips, the abundant manuring and subsequent hoeing, are as effectual in cleaning the land and bringing it into a fertile state as any complete fallow could ever be; and the clover smothers and destroys the weeds which may have come up among the barley or oats sown after the turnips.

On heavy soils it is often impossible to keep the land clear of weeds, in wet climates and unfavourable seasons, without a complete fallow, and when this is the case it is best to do the thing effectually. Upon cold wet soils, which should always first of all be well underdrained, no pains should be spared to get the land perfectly clean. The advice given by a celebrated agriculturist to farmers was—"Avoid fallows if you can keep your land clean; but when you fallow, do it effectually, and improve the soil at the same time by chalk, lime, or marl. Do not spare either ploughs or harrows in dry weather. In short, neither ploughing nor manuring alone will keep a soil in a good fertile state. There must be an occasional fallow for some soils, and turnips or similar husbandry for others." See AGRICULTURE.

FAL'MOUTH, a municipal and parliamentary borough and seaport in Cornwall, 311¾ miles from London by the Great Western Railway. The town is situated on the west shore of the estuary of the river Fal, and consists principally of one street, which extends along the south-west shore of the harbour for about a mile, and of some beautiful suburban villas and terraces on the heights behind. In 1878 a well-laid-out park was presented to the town by Lord Kimberley. The Public Rooms, a handsome building, is situated in the heart of the town; and not far from it is the Polytechnic Hall, a spacious and commodious structure, in which are held the annual exhibitions of the Royal Cornwall Polytechnic Society. A town-hall and court-house were erected in the market-place in 1866, and there are also a public library, mechanics' institute, several schools and charitable institutions. Among the latter is a house for fifty aged and deserving poor, erected in 1870, and endowed by Mr. G. Earle, of Philadelphia, who emigrated to America some years before. The population of the municipal borough in 1881 was 5973. Falmouth unites with Penryn to return one member to the House of Commons. The number of electors is 2400.

The harbour, which is one of the best in England, is an extensive bay, well protected by the surrounding highlands, and so conveniently situated that vessels have frequently been able to proceed on their voyage from this port, while those from Plymouth and Portsmouth have been forced back by contrary winds. It is defended by two old castles; one, towards the west, called Pendennis Castle, and the other, towards the east, called St. Mawes. Oysters abound over all parts of the harbour, and a valuable fishery is carried on, which contributes a considerable part of the London spring supply. There is a lighthouse on St. Antony's Point, at the east side of the harbour, and also an obelisk on the Black Rock, which rises out of the sea near the middle of the entrance to the harbour, between Pendennis and St. Mawes. The exports consist principally of the produce of the tin and copper mines in the neighbourhood and of pilchards, and the imports of cattle, corn, fruit, spirits, wine, hemp, tallow, timber, and coal. The shipping is chiefly coastwise, but there is also some foreign trade and a little traffic with the colonies. Commodious and extensive wharves, docks, warehouses, and other conveniences exist at the entrance of the harbour of Falmouth, which, as a place of call for orders, is more frequented by merchant shipping than any other in the United Kingdom. Steam communication exists with the Cape of Good Hope, Dublin, Liverpool, Plymouth, and London. The town was formerly an important mail-packet station, but it is now superseded in this respect by Plymouth and Southampton.

The number of vessels registered as belonging to the port in 1884 was 135 (14,500 tons). The entries and clearances average 1000 (150,000 tons).

The municipality consists of four aldermen and twelve councillors, including the mayor. Falmouth means the "mouth of the Fal or Prince's River," and was first so called in 1660. The original name seems to have been *Pen y cwm guic*, meaning "the head of the creek valley," corrupted into *Penny-come-quick*. Another former name for it was *Smithic*, meaning "the smooth haven." A great deal of its prosperity is owing to Sir Walter Raleigh. During the Civil War Pendennis Castle played a prominent and interesting part, and was the last of the castles, except Raglan in Monmouth, which held out for the king's cause. The advantages of the magnificent and famous harbour of Falmouth (now unfortunately silting up), which receives the waters of 170 square miles of country, were known at a very early period—probably even to the Phœnicians, as evidenced by the singularly shaped block of tin dredged up at Falmouth, and now deposited in the museum at Truro.

FALSE, in music, is a term of frequent use, somewhat corresponding to the "irregular" of the grammarians. *False intervals* are those which have not their full number of semitones, as a "false Fifth," more usually and perhaps more properly styled an imperfect Fifth, &c. [See INTERVAL.] *False cadence* is a cadence which breaks away from the expected close. [See CADENCE.] It is better called an "interrupted cadence." *False intonation* is

singing or playing out of tune, that is, a little sharper or flatter than the true pitch according to the scale being used at the moment; or a want of steadiness and purity of tone, as especially is the case with a *false string*, where the upper partials confuse the prime tone and the tone is rendered uncertain. *Falsa musica* also was music containing accidentals, in the dawn of our modern music; for the strict style of that period permitted only the "natural" notes to be used. *False relation*, finally, is the most important of all these musical falsities. It consists essentially in the use of a note or chord foreign to the key in which the music at the moment rests. The principal varieties are three:—1. When one part has a natural note and another part has a sharp or flat note of the same name, and both notes are sounded in the same chord. 2. When the notes in false relation are sounded in successive chords. 3. When they are sounded in chords which are separated by only one chord.

False Relation. 1 2 3

Exceptions to 2 are when the Third of the first chord is the Root or is the Fifth of the second chord. Exceptions to 3 are when the chromatic note forms part of a fundamental discord, or when the first chord contains the minor Seventh sometimes used in the minor key, and one or two other exceptions of like nature. Chromatic passing notes induce no false relation if all the rules for their treatment be observed. Thus Mozart in the exquisite "Lacrimosa" of the Requiem begins the movement thus, closing the bar with a C♮ in the first violin part, against a C♯ in the second—

Violino 2do. and Viola.

FALSET'TO, in music, an Italian term, signifying a false or artificial voice, produced by tightening the ligaments of the glottis, and thus the vocal compass is extended about an octave higher. The Italians call the falsetto *voce di testa*, or voice from the head, and the natural voice *voce di petto*, or voice from the chest.

FAL'STER, a Danish island in the Baltic, lies south of Zealand and east of Laaland, between 54° 30′ and 54° 58′ N. lat., 11° 45′ and 12° 11′ E. lon. The strait called the Gaabensesund separates it from Zealand, and the Guldborgsund from Laaland; on the N.E. the Groensund divides it from the island of Moen. Its greatest length from north to south is about 25 miles, and its greatest breadth from east to west is about 16 miles. The area is 180 square miles, and the population 30,000. It is accounted one of the best cultivated and most productive parts of the Danish dominions. The surface is level, and in the south the island terminates in two tongues of land, formed by an arm of the sea called the Noret. The western tongue has a lighthouse upon it, beyond which a reef of rocks extends far into the sea. The produce of grain is more than equal to the consumption, so that between 30,000 to 35,000 quarters are annually exported. Flax, hemp, hops, potatoes, &c., are grown. Large quantities of fruit are raised, and apples in particular are a considerable article of exportation. The woodlands occupy about one-sixth of the whole surface. Horned cattle, sheep, and swine are bred. Much wax and honey are obtained; and poultry, geese especially, are abundant. There is in the island a large lake called Mariboersee, from which there is an outlet into the sea. There are no important manufactures in the island. The imports are colonial produce, salt, and tobacco; and the exports agricultural produce, salt meat, and live stock. There is some shipbuilding. Nykiöbing is the chief town.

FA'LUN or **FAH'LUN,** a town in Sweden, the capital of the province of Dalecarlia, lies 54 miles W.S.W. of Gefle, and has a population of about 6000. The town is built in a wide valley between two lakes, which are not far from it. The great copper mines, the oldest and most celebrated in Europe, are on the west side of the town; the entrance is by a funnel-shaped excavation, like a volcanic crater, 300 feet deep, and 3000 feet across at top, down the sides of which steps have been cut. From the bottom of this galleries, adits, and chambers, some of which are magnificent, run in all directions, and vertical shafts descend, of which the deepest is 200 fathoms. The mines are known to have been worked for upwards of 600 years, and they were probably in operation several centuries earlier. The produce was formerly from 1250 to 2000 tons of metal annually, but has now diminished to about 400 tons. The country around is hilly, but bare of vegetation, from the effects of the fumes produced in the smelting; yet these seem not injurious to health, and they preserved the district from cholera, as at Swansea, during the several visitations. There are in connection with the mines a mining school, museum, library, and model-room. Falun is regularly built.

FA'LUNS, a series of shelly beds found in Touraine, belonging to the Miocene epoch; indeed Lyell selected them as the type of his proposed middle division of the Tertiary—the Miocene. They vary in thickness up to a maximum of about 50 feet, and from their richness in shells have long been used as a source of shell-manure. Upwards of 300 species of molluscs occur in these beds.

FAMAGUS'TA, a fortified seaport town of Cyprus, on the east coast, a little south from the mouth of the Pedæa, and 40 miles east of Nicosia. In its centre are the remains of the Venetian palace, near the Cathedral of St. Sophia, a respectable Gothic building, in ruins, and in part converted into a mosque. During the Venetian regime it was one of the most populous, commercial, and richest towns in the Levant. Its ruin was completed by an earthquake in 1735. About 5 miles N.E. are the ruins of Constantia, occupying the site of the ancient *Salamis*, now called Eski, or Old Famagusta. These ruins consist of the foundation of the ancient walls, about 3 or 4 miles in circuit; with cisterns, broken columns, the foundations of buildings, &c., which lie scattered along the sea-shore, and near the mouth of the Pedæa.

The harbour of Famagusta consists of two parts—first, the ancient or inner harbour, which adjoins the town, and which, though doubtless sufficiently deep in former days for the small vessels of those times, will not admit the large ships that are now used in the foreign mercantile trade of Great Britain. Secondly, the outer harbour, which extends in a north-westerly direction from the mouth of the inner harbour. This is a natural harbour formed by a reef of rocks running parallel to the coast for a length of over 1½ mile, and at a uniform distance of half a mile from the land. The entrance to the harbour is sheltered by the promontory of Carpas.

Guy of Lusignan was here crowned king of Cyprus, by order of Richard I., in 1191. It remained in the possession of his family till 1460, and then successively belonged to the house of Savoy and the Venetians. Selim II. took it after a long and memorable siege in 1571, when its gallant governor, Bregadino, met with treacherous and inhuman treatment.

FAMILIAR, or **FAMILIAR SPIRIT.** See MAGIC.

FAMILY, THE. Natural as it seems to us that our association of father, mother, and children should exist with an almost sacred force, and should form the unit, we find on even a cursory survey of the earliest times, and of the lowest races of our own times (which the most competent authorities consider to represent, preserved as it

were in a fossil state, types of existence long anterior to any records), that no such institution exists. In the article MARRIAGE the sexual tie and the family relationship of savages is fully dealt with; it will suffice here to say that it is evident that in the earliest times a woman belonged to the tribe and not to one man in especial, and that the children were children of the tribe. In races of a higher development the mother is held as a relation, but not the father. In still higher races the father and not the mother is related to the child; and this type was existent down to the heroic times of Greece, as we see in the myth of Orestes. Orestes killed his mother Clytemnestra to avenge her murder of his father, her husband. The Furies seized him. He asked why they let Clytemnestra go unpunished. They replied that she was no relation to her husband. "But neither am I a relation to her," said he; "she is my mother, not my father;" and the Furies let Orestes free upon this plea. The Romans held very greatly to this view, so far modified as to give the husband's and not the wife's name to the children, and to cause the wife, while retaining her own family name, to be regarded as by adoption of the family of her husband. The son of a Julius and a Livia was a Julius, not a Livius. But though a child did not bear its mother's family name, and though the father, as will appear below, was supreme in the Roman family, yet a child was regarded as equally the relation by blood of its mother and of its father. Indeed the difficulty is to believe that so simple and natural a view was not held from the very first, instead of being the final and fourth degree of stages each of which probably existed for long epochs in the history of mankind. For the institution of the family, as we know it, which lies at the root of all our social polity, we are indebted, as for so much else in the social fabric, to the genius of the Romans. No nation ever so thoroughly worked out the natural evolution of the family, and consequently no system of families has ever equalled the Roman for permanence before or since. Great families are met with in the dawn of Rome's greatness which last through all that wonderful career of empire.

The Roman family consisted of the citizen, "who upon his father's death had become his own master, and the spouse whom the priests by the ceremony of the sacred salted cake (*confarreatio*) had solemnly wedded to share with him water and fire, with their sons and sons' sons (and the lawful wives of these) and their unmarried daughters and sons' daughters, along with all goods and substance pertaining to any of its members" (Mommsen). Their married daughters and the children of these had, of course, gone to the family of those whom they had married. A house of his own and the blessing of children appeared to the Roman citizen as the end and essence of life. The death of the individual was not an evil, for it was a matter of necessity; but the extinction of a household or of a clan was an evil even for the community itself, which in the earliest times, therefore, opened up to the childless the means of avoiding such a fatality by their adopting, in presence of the people, the children of others as their own. Men alone could be heads of families, although women were perfectly their equals before the law, possessing separate estates, &c., while daughters inherited equally with sons. But the law stopped at the threshold—the head of the family ruled supreme within. That stern *patria potestas*, the paternal authority, still supreme among us, except so far as wise parents have voluntarily accommodated themselves to the less fierce manners of our altered times, was pushed to excess among the Romans. Wife, son, and daughter were subject to the despotic authority of the husband and father, even to personal restraint or castigation. Nay, the punishment of death was sometimes inflicted by an outraged father, but the law did not interfere. The word family shows most strikingly the view of relationship held by the Romans, for it is directly derived from *famuli*, slaves. On the other hand, the feeling of Roman fathers for their family amounted to veneration. It was sacrilegious, most horrible, in their eyes for a father to neglect his child's training or squander his property. But as long as the father lived he held the whole property of the family; if a son chose to live apart, and even if he grew wealthy and powerful, his possessions were not his own but his father's—he held exactly the position of a slave managing a distant estate. True, the priests cursed a father who sold his son, but it was a settled maxim with Roman jurists that even that was not beyond a father's right. In fact, the head of a family was an independent potentate as regarded his family. Assuredly while there are many benefits of the Roman custom we regret to have lost, this we are devoutly glad to be rid of. It is only just to add that this despotism was more theoretical than real, for Romans were, as a rule, though very stern, yet admirable fathers. At the death of the head of the family, all the sons became its masters and obtained the rights over the women and children and property hitherto exercised by their father. But the family did not altogether break up. The widow and unmarried daughters of the deceased, not being able to be heads of families, were nevertheless allowed to retain their dwelling and enjoy their property under the collective guardianship of the whole family of sons. So the family perpetuated itself, and when by division and subdivision the exact relationship to the original founder was no longer traceable, still the families descended from him bore the common *gentile* name; the great *gentes*, or clans, of Rome being nothing more than aggregated groups of families of common descent from original founders lost mostly in the obscurity of antiquity.

To these great patriarchal families, with their several generations dwelling together really or nominally under their venerable head, with numerous slaves (*famuli*) and retainers, it is easy to see how naturally many foreigners or poor men of no family would eagerly attach themselves. These also formed in one sense part of the family, and were called *clientes* (listeners), and their fortunes and even their lives became the nominal property of their *patron*. This nominal right again was hardly ever, if indeed ever, acted upon; but it was perfectly acknowledged. And just as with the stern rights of parents over children, so also with the rights of patrons over clients, they were held to entail, and honourably were allowed to entail, a very real and active protection on the part of the head of the family to those who had placed themselves under his authority.

Upon this view of the family was based the early Roman kingship, the king when once elected acquiring precisely the power over the state, and the answering responsibilities, which the father had over his family; and death alone terminated his power. Also, just as in grave cases it was held imperative for the father to call his friends together to consult them, so the king called together the elders of the state (*senes*) in the *Senate* to aid him with their advice. Further, as the son was equal with the father except as regards his authority, so also was the subject fully the equal of the king; no divine right or limitation of family was recognized. What is reported in that way is merely the invention of later times; a specimen is afforded by the courtly flatteries of Virgil in the Æneid.

This was the original life of the Romans; and though the kingship gave way to the republic, and that to the empire, the family, in its main lines at least, existed down to the latest times very much what Mommsen has sketched in the account which we have condensed above (Mommsen's "Rome," translated, London, 1881).

As in the family slaves worked in sets, the term "family of slaves" grew up; and later on in Roman history we get also a "family of gladiators," a "family of huntsmen," or beast-fighters, &c. These "families" were under the control of the state or of some private proprietor.

With ourselves the family arrangements are fast changing. It once was the case, and that in the memory of those now living, when all that was a wife's became her husband's; the Married Women's Property Acts have altered that for ever. Until the first of these useful statutes was passed, in 1870, costly settlements and trusts enabled the rich alone to protect their daughters. Again, up till quite recently, the iniquitous custom of primogeniture heaped all the property of a family upon the eldest son, leaving only the personal estate of the head of the family for division at his death among the younger sons. In this way the professions were overstocked with men who in many cases were quite unfit for them, but who dare not take to trades or to occupations which they might have honourably filled, for the sake of preserving "the honour of the family." This now is rapidly passing away, and the sons of dukes earn an honourable living among the merchants of our cities, instead of perfunctorily filling better men's posts in pulpit, regiment, or state-office, performing work they dislike and therefore do badly. In a few years, no doubt, the equitable system of France, Roman in its origin, will also prevail among ourselves, and in fact large numbers of the wiser fathers already adopt it in our day when making their last dispositions—that is, the equal division of property among the children after due provision for their mother, if she be living. But to make this compulsory, as it is abroad, is perhaps not wise; for it is found in France that, as no power can debar a child from inheriting his share, wicked children are tempted to anticipate the division, or to treat their father or mother with disrespect, or even to long for, if not to hasten, the end of their parent. The only way to defeat such a child is to distribute the property among the others while the parent is yet living—a dangerous remedy.

The English family breaks up, except by voluntary arrangement, as each child attains the age of twenty-one. After that age the father has no legal control over his children.

Many social reformers have inveighed against the selfishness of the family loyalty to the chief and to each other. But the virtues of the honourable pride in not disgracing one's family, the sacrifice of individual interests to the interests of the family, the help which, under penalty of social ostracism, the rich brother must give to the poor, the support of parents in their age and weakness, and finally the strength of union typified in the fable of the "bundle of sticks," cannot any of them be so efficiently provided for in any other way. Consequently the pantisocracy of Coleridge, the phalanstery of Fourier, the communities of Robert Owen, the Brook Farm of the American socialists (which Hawthorne, himself a member, has immortalized in the "Blithedale Romance"), and all such communistic or socialistic attempts to destroy the family, have utterly failed. As yet the discipline of the family is the only thing strong enough to organize our inherent selfishness.

FAMILY, in *botany*, is mostly applied to a group of plants of the same value as Natural Order. In this sense it has been mostly employed throughout the pages of this work. At the same time, in the arrangements of some writers, a family is made a group of less value than an order; while in the writings of others the term is loosely applied to distinguish any group of plants of higher value than a single species. It is thus sometimes employed synonymously with genus. The names of natural orders being mostly those of a genus, which serves as a type for the rest of the group, are easily Anglicized by adding the word family. Thus the order Gentianaceæ is called in the English the Gentian Family, and so on. By this means the word family is sometimes restricted to the species of a genus. Another word used synonymously with natural order by Dr. Lindley is tribe. In his natural system all the orders having typical genera with English names have been called tribes, with the English names attached. Thus, Cinchonaceæ, the coffee tribe; Pistiaceæ, the duck-weed tribe; Euphorbiaceæ, the euphorbium tribe. At the same time tribe is frequently used to express a group of less value than an order, as in the larger orders, Umbelliferæ, Leguminosæ, Compositæ, Cruciferæ, &c.

In *zoology* the subkingdoms are broken into classes, and the classes into orders. The orders are broken into families, and under the families, as in botany, many genera are grouped. Thus the dogs, wolves, foxes, and jackals are all grouped under the family Canidæ, one of the families of the order Carnivora.

In *languages* those separate languages which yet show such marks of descent from some common ancestor as to justify their being so grouped together, are held to form a family. The word here has a larger signification than in the biological sciences, it will be observed. The main families of language are the Aryan or Indo-European, to which we belong; the Scythian, of which Hungarian and Turkish may stand for types; the Chinese, the model of a monosyllabic language; the Japanese; the Malay; the Semitic (Hebrew, Arabian); the Hamitic (Egyptian, &c.); the North American and the South African, &c. Certain tongues refuse to range themselves with any family, such as the Basque, the Caucasian, &c. See LANGUAGE.

FAMINE is the term used to express a scarcity of food over an extended area. Famine together with pestilence, which generally arises from it, are the most terrible scourges from which a community can suffer; but the spread of civilization by improved transport has done much to lessen the danger arising from the first, since the world as a whole always produces enough food for its inhabitants.

The causes predisposing to famine in particular countries are either abnormal, climatic, and natural conditions—such as frosts at an unusual time, destroying the tender shoots, excessive rain, causing floods, the opposite long-continued drought, and the destruction of the crops by insects and vermin—or artificial difficulties, created by the action of man himself. Among the latter must be enumerated war, which acts in various ways, checking the transport of food from market to market, withdrawing men from the cultivation of the soil, and destroying the growing crops; want of knowledge or enterprise in the cultivators, who fail to raise the crops most suitable to the soil, or are satisfied to raise only enough to meet their own expected requirements—causes which have so often helped to occasion famine in Ireland; and absence of means of transport, the fruitful source of suffering in India. To the latter causes must be added the still more artificial and temporary effects of unwise legislation; of illegitimate commercial transactions, such as forestalling; and of the misapplication of food, as illustrated in the excessive employment of grain for brewing purposes.

According to a calculation made by Mr. Cornelius Walford in a paper in the *Statistical Journal* "On the Famines of the World, Past and Present," 350 famines have been recorded in the history of the world, including those of early scriptural times.

FAN, an instrument used for giving motion to the air. Its use for imparting coolness to the face dates from a very remote period. In many of the Egyptian sculptures representations of the fan are to be found, and in the celebrated museum of Boulak a fan handle is preserved, taken from a tomb of the seventeenth century before our era. The use of the fan can be traced in the early history of the Assyrians, Hindus, Chinese, Japanese, and other nations of the East, while its use in hot countries may be regarded as universal at the present day. The religious uses of the fan are remarkable. The Jews used it from time immemorial to prevent the flies, emblems of Beelzebub, from settling on the embroidered case of the *torah*. So also in an ancient French chronicle we find a fan noted in the

inventory of the Abbey of St. Philibert at Tournus, whose use was to keep flies from falling into the sacramental wine, and this very fan was exhibited in Paris in 1867 (see Uzanne's excellent work on the Fan, translated, London, 1883). Probably in this use, or symbolizing this use, originated the magnificent fans of peacocks' feathers which are borne before the pope on occasions of great ceremonial. The use of fans for this purpose is still kept up in the Greek Church and throughout the East, and in this particular, as in several others, the Greek use is the more ancient, for in the liturgy of St. Clement is a rubric clearly directing two deacons to stand one on each side of the altar to keep away the unholy flies, Beelzebub's children, by waving "fans of vellum, fine linen, or peacocks' feathers." In the curious church of the native Egyptian Christians, the so-called COPTS, much has been preserved of the greatest value in an antiquarian sense. The Coptic language itself exists only as a religious tongue, unknown to the priests who mutter it, and who gather its purport by translations. In this dead-alive church are many fans preserved in the same manner, and their meaning is so entirely forgotten that the priests use them on festival days as ornaments wherewith to surround the sacred copy of the Gospels then specially brought out, sticking round their edges a fringe of little wax tapers. These Coptic fans are of silver (as indeed are also the Greek fans for the most part) and are about 7 inches across, with rude figures of cherubim, &c., in repoussé work.

Fans have also formed a necessary part of the outfit of a lady from the earliest times in Europe, and they have frequently been made the vehicles for extravagant luxury and display. Addison's essay on the fan, in No. 102 of the *Spectator*, is one of the most charming pieces of ridicule in our language. At the present day much taste and skill are employed in the manufacture of fans, some of the finest specimens being the production of Parisian artists. The practice of painting fans with groups of figures or clusters of flowers has within late years been revived in England under royal patronage, and some interesting exhibitions of ancient and modern work have been held, as for instance in London in 1872, in Liverpool in 1877, &c. A special variety of ladies' fans came into use during the licentious comedy of the Restoration. These theatre-fans were pierced with a hole, so that, while the wearer could hide the blushes which rose to her face, or feigned to hide the blushes which refused to come, she could still gaze upon the plays which were supposed to be revolting to her modesty. The fan even served as a head-dress for a short time, being introduced in this character by Mdlle. de Fontange, mistress of Louis XIV.

In addition to its use in ministering to personal comfort the fan has been employed in the winnowing of grain from very early times. A reference to this use is found in the Old Testament, Isa. xxx. 24; and there is another in the New Testament, Mat. iii. 12.

Large revolving fans driven by machinery are frequently used to facilitate the cooling of fluids, to drive away noxious dust given off during certain mechanical processes, and to assist in ventilation.

FAN PALM, a name given to palms whose leaves are fan-shaped. The genera Corypha, Hyphæne, Livistona, Mauritia, &c., supply samples of the well-marked fan-shaped leaf.

FAN TRACERY, a beautiful form of vaulting found in the Gothic architecture of the fifteenth century, which derives its name from the manner in which its system of arrangement suggests a fan. The ribs or veins which form the vault spring from the cap of the shaft with a regular outward curve, and at equal intervals, round a curved cone or polygon. The spaces between the ribs are filled in with a rich tracery of foils and cusps. The best examples of this form of architectural adornment are to be seen in King's College, Cambridge, St. George's Chapel, Windsor, and Henry VII.'s Chapel, Westminster Abbey.

FANAR'IOTES, a name applied to the inhabitants of the Fanar or Greek quarter of Constantinople. After the capture of Constantinople by the Turks, the Greeks of the Fanar, taking advantage of the ignorance of the Turks, succeeded in rendering themselves necessary to the ministers of the Porte as translators, and to other Turkish grandees as secretaries, agents, and men of business in general.

Interesting pictures of the Fanariotes are given in Mr. Hope's novel of "Anastasius," and in Von Hammer's "Constantinople." Though Turkish administration is still practically in the hands of the Greeks, the term Fanariotes has long since become merely historical.

FANCY, a corruption of phantasy (Gr. *phantasia*), which term in ancient philosophy indicated the sensuous appearance of an object, and in a general sense was used as coextensive with conception, or the faculty by which man reproduces images of objects, either absent or present, without an immediate impression on the organs of sensation. At present the use of the word is vague, and it is often used as synonymous with imagination. Those who affect to give it a meaning as distinct from imagination are not very successful in their definitions.

FANDAN'GO, a Spanish dance of Moorish origin, a variety of the chica or of the seguidilla, was originally in 6-8 time, of slow movement. Later it assimilated itself more to the bolero, and is now written in 3-4 time. It is danced by pairs of dancers, a man and a woman together. Mozart has immortalized it as a dance form by using it in his "Nozze di Figaro" (Act 3). Like most Spanish dances it almost requires the castanets and the tambourine to accompany it, and goes to nothing so well as to the guitar. The fandango has been the theme of history, and the subject is a favourite one with painters. When it arose, about 200 years ago in Andalusia, it was condemned by the church as soon as it began to be popular. But some of the ecclesiastics declined to prohibit a matter of which they knew nothing. Consequently two famous dancers were required to perform the fandango, and did so with such effect that many bystanders among the council joined in heartily, and the proposed censure was averted amid the merriment of all.

FAN'FARE, a short passage for trumpets, announcing the opening of a state ceremony, &c.; a "flourish of trumpets." It is always in unison in the best examples. The following fanfare is given by Sir George Grove ("Dictionary of Music," London, 1884) as dating from Charles II. in the household cavalry. It is played by the eight royal trumpeters, and is always used at the opening of Parliament, the proclamation of peace, &c.

FANG (Anglo-Saxon *fengan*, to seize, the root from which the word *finger* is derived). Used as a noun, it is generally applied to the canine teeth of the carnivora or of reptiles.

FANO. See PESARO.

FANTAIL (Rhipidura) is a genus of passerine birds belonging to the family Muscicapidæ (FLYCATCHERS). Both the common and the generic name have reference to the possession by these birds of a long broad tail which spreads out into a fan when they are in motion. The species are rather numerous, and range through India and China, the Malay Peninsula and surrounding islands, to Australia. The Black Fantail (*Rhipidura motacilloides*), the wagtail flycatcher of the colonists, is distributed over all parts of the Australian continent. It is of a glossy black colour, with the wings brown, and the lower surface, except the throat, and a small streak over each eye pure white. It is a lively, active, and familiar bird, haunting the neighbourhood of the houses, and seeking for its insect food not only in the gardens but also about the cattle, upon the backs of which it will frequently alight and run along. Much of its prey is sought on the ground. In appearance it resembles the European wagtails; like them it has the habit of shaking its tail, but the movement is from side to side, and not perpendicular. It constructs a beautiful cup-shaped nest of dry grass, roots, and strips of bark, held together by cobwebs, and usually rears two or three broods in the season.

The White-browed Fantail (*Rhipidura albofrontata*), a nearly allied species, is common in the northern parts of India, where it frequents both the jungle and gardens. It captures much of its food upon the wing, but, like its Australian relative, is sometimes seen perched upon the backs of cattle. Mosquitoes constitute a great portion of the diet of this bird, and hence one of its Indian names signifies mosquito-catcher.

FANTAS'IA, a musical composition which does not follow the ordinary divisions of musical form. It is a favourite style of composition with pianoforte composers, Beethoven's marvellous "Moonlight" sonata being expressly entitled "Quasi Fantasia," and Mozart, Mendelssohn, and Schumann having left superb examples. Though the composer is left free from the time-honoured treatment of "first" and "second subject" and their "development," &c., it is not intended that the fantasy shall be a mere vague outpouring of rambling disconnected thoughts. Unfortunately some modern composers have seemed to think so, and confuse liberty with license, to the great fatigue of their bewildered listeners.

FAR'AD, one of the electro-magnetic units, so named in honour of Michael Faraday. It is the unit of *capacity*. The farad is such that a condenser of one farad capacity would be raised to a potential of one VOLT by a charge of one AMPERE of electricity. But as this would be a very large condenser, the *micro-farad* is the practical unit in use, and it is the millionth part of a farad. A micro-farad condenser contains about 3600 square inches of tin-foil surface.

The farad itself is not the "absolute" unit of capacity, but the thousand millionth part of this (10^{-9}). An "absolute" unit of capacity on the centimetre-gramme-second system of measure, that is to say, a capacity of 1,000,000,000 farads, is possessed by that conductor which requires a unit of quantity to bring its potential from zero to unity. It is of course quite unworkable.

FAR'ADAY, MICHAEL, F.R.S., an illustrious English chemist and natural philosopher, was born in the parish of Newington, Surrey, on the 22nd September, 1791. His father was a working smith, and his education was of the most rudimentary description. At the age of thirteen he was apprenticed to a bookbinder, and in this position he greedily devoured all the books that fell into his hands, but especially those of a scientific cast. These he mastered so thoroughly that he contrived to construct some simple apparatus and to make a variety of interesting electrical experiments.

Having been enabled, through the kindness of a Mr. Dance, to attend some lectures delivered at the Royal Institution in 1812 by Sir Humphrey Davy, Faraday took some careful notes of them, which he rewrote with illustrative drawings, and ventured to submit them to the great chemist. Davy discerned the young man's ability, and in the following year procured him an appointment as chemical assistant at the Royal Institution, to which he removed, and where he continued to reside, with the exception of a short interval, until his death.

The record of a philosopher's life is generally uneventful. Of Faraday nothing more need be said than that his services to science were of the most important description, while his character as a man was absolutely without spot. He was a devout Christian, belonging to one of the strictest Nonconformist sects, and an unassuming, charitable, genial, and honourable English gentleman.

His principal scientific labours may be briefly enumerated. In 1820 he discovered the chlorides of carbon, and in 1821 the mutual rotation of a magnetic pole and an electric current. Various successful experiments on the condensation of gases distinguished the year 1823. He began his experimental researches in electricity in 1831, continuing them until almost the end of his life; and so important were the results attained that his name will be associated with electricity as indissolubly as that of Newton with gravitation. In 1846 he received the Royal and the Rumford medals for his remarkable discoveries in diamagnetism, and his researches into the influence of magnetism upon light.

In 1827 he began a series of lectures on scientific subjects at the Royal Institution, Albemarle Street, which he continued yearly up to 1867. In 1833 he was appointed professor of chemistry at the institution. In 1835, at the instance of Lord Melbourne, he received from the crown a well-merited pension of £300 per annum. Although Faraday's fame is especially associated with electricity and magneto-electricity, his labours were not limited to this branch of science; the extent of his researches is evidenced by his published memoirs on other subjects, as well as by his public lectures. With the highest qualities as an investigator, he possessed the happiest power of expounding to a general audience the result of the most recondite investigations. One of the most remarkable traits in his character as a philosopher was that, detesting half-truths, he never announced a discovery or propounded a theory until it was perfect. Under the pressure of long-continued devotion to profound scientific research, his mental energies gave way a short period before his death, which occurred on the 25th August, 1867.

He was chosen a corresponding member of the Academy of Sciences of Paris as far back as 1823. In 1825 he was elected a fellow of the Royal Society, and in 1832 the University of Oxford conferred upon him the degree of D.C.L. He was also one of the eight foreign associates of the Imperial Academy of Sciences of Paris, a commander of the Legion of Honour, knight of the Prussian Order of Merit, knight of the Italian Order of St. Maurice and Lazarus, and a member of numerous scientific and learned bodies in Great Britain, France, Prussia, and the United States of America. His "Life and Letters," by Bence Jones, was published in two volumes in 1869.

FAR'ANDOLE or **FARANDOLA**, a dance peculiar to the south of France and the north of Italy. The dancers form a long chain, hand in hand, men and women alternately, all the men facing one way and all the women the other. This long line winds in and out in intricate figures, turning and twisting wildly along the streets till the dancers become perfectly mad with excitement. It would seem the nearest remaining dance akin to the terrible revolutionary CARMAGNOLE, which Dickens has so vividly described in the "Tale of Two Cities." It was under the excitement of the farandole that Maréchal Brune was murdered at Avignon in 1815.

FARCE, an absurd sort of comedy, derives its name from the Latin *farcire*, to stuff (French *farcir*), because it is stuffed full of whims and oddities, in much the same way that "stuffing" is used to enhance the flavour of delicate meats. In fact our *force-meat*, the cook's name for certain preparations of "stuffing," is this very word *farce* corrupted. In mediæval times *farsia* or farce was a religious canticle-play of which the ecclesiastical Latin basis was stuffed with interpolations in the vulgar tongue. It was very popular at Christmas in France and Italy, and to a less extent in Germany, and took form in the middle of the fifteenth century at Paris as an entertainment distinct from the religious miracle-plays. The "Farce de Maître Pierre Pathelin" is the most famous of these genuinely national productions. Like the FABLIAU, the farce dealt with any situation of ordinary life to which a comic character could be given by the treatment. Farces were about 500 lines long, always in eight-syllabled regular verse, and with very few (sometimes only two) actors. Satires against priests and women are frequent; the henpecked husband and the scolding wife are favourite characters, and the stick plays a great part. From this beginning French comedy gradually arose, and it is most curious to trace the large remains of the old farce element in the inimitable works of Molière.

Modern farces follow on the ancient lines in great part, and the more absurd an idea is the better is it suited for farcical purposes. At the same time a farce in three or more acts, which is quite common on the French stage, seems to Englishmen to be pushing what should be a mere trifle too far; and English farces usually run from twenty to forty minutes only, during which time the fun is (or should be) fast and furious. Their position is either at the beginning of the evening, to put the audience in a good humour, or at the close, to send them away merry.

FAREHAM, a market-town of England, in the county of Hants, 10 miles N.W. from Portsmouth, and 83 from London by the London and South-western Railway, situated on a creek at the north-west extremity of Portsmouth harbour. A fair trade is carried on, vessels of 300 tons coming up to the quays. There are exports of pottery, which is the chief manufacture, oak-bark, and bricks; and coal, timber, and general produce are imported. The coach-factories, malt-houses, and breweries are large; besides which there is a tannery, tobacco-pipe and whiting work and a shirt-collar manufactory. The principal buildings are the market-hall; the corn exchange, the great hall of which serves as an assembly room; the parish church, and various chapels. There are public salt-water baths, good hotels, and a mechanics' institute, and in the neighbourhood several fine seats and parks. Population of the parish, 7183.

FAREL, GUILLAUME, one of the most eminent of the reformers, was born in 1489 at Gap in Dauphiné. He was of noble descent, and studied at the University of Paris where he received from Lefevre d'Etaples the spiritual illumination which the reading of the Bible had conveyed into his own mind. Having finished his studies, he lectured as professor in the college of Cardinal Lemoine. Compelled by the persecution which in 1523 broke out in France against the reformers, he fled to Basel, where he formed the acquaintance of Œcolampadius; and at his instigation, and with consent of the magistracy, he challenged the theological faculty there to discuss publicly with him certain theses, involving the leading points of the reformed theology. The disputation took place on the 15th February, 1524. The opposition of his enemies, however, compelled him to flee to Strasburg, where he was welcomed by Bucer and Capito. We next find him at Mömpelgarde, the residence of Duke Ulrich of Würtemberg, where, though not ordained, he acted as preacher. After some time he arrived at Geneva, where he at first held private meetings in his own house; but these becoming much resorted to, he was summoned before the bishop's vicar, Amadée des Gingins, to answer for himself as a misleader of the people. With difficulty escaping with his life, he fled to Orde; but his soul longed after the work he had begun at Geneva, and in 1533 he returned to the city under the protection of the state of Berne. At length Calvin came upon the field, and Farel seized and detained him as the instrument raised up by Providence to complete the work. In 1565 he visited Metz, where he preached with all the fire of his youth. This was his last effort. He died on 13th September, 1565.

FARINEL'LI. Carlo Broschi, who adopted the sobriquet of Farinelli because his father was a flour-dealer (*farinello*), was born in 1705, and was probably the finest male soprano who ever lived. An accident while riding in boyhood necessitated a surgical operation, and as a consequence the boyish treble voice never broke. He was the pupil of the famous Porpora, and reached the most astonishing perfection of vocalization while yet a boy. In 1734, when at the height of his fame, he visited England, and created such a *furore* that a lady was heard to exclaim at the theatre, "One God, one Farinelli!" (See Hogarth's "Rake's Progress.") He was fond of beginning a note with great delicacy, swelling it out to amazing volume, and then diminishing it gradually till it died away, just before one of his passages of phenomenal rapidity, so that each feat enhanced the other. The Prince of Wales gave him a magnificent diamond snuff-box, and the whole court followed suit. He built a fine mansion in Italy out of his large English gains. He charmed the *blasé* Louis XV. in like manner in 1736; and making soon after that a trip to Spain he produced so magical an effect upon the half-mad melancholy Philip V. (grandson of Louis XIV. of France), that the queen retained him at any cost to alleviate the misery of her consort. Farinelli sang four songs every evening without changing one for ten years, so he assured Dr. Burney. He assumed almost the power of a prime minister, received the highest dignities and decorations, and engaged deeply in politics. He remained in Spain in this extraordinary position for twenty-five years, twelve under Philip and thirteen under his son Ferdinand. But Charles III., brother of Ferdinand, who ascended the throne in 1759, desired Farinelli to withdraw to Italy. He lived in considerable affluence near Bologna for twenty years longer, winning respect from all. Burney saw him in 1771. He died in 1782.

FAR'INGDON, a town of England, in the county of Berks, situated in the Vale of the White Horse, 36 miles north-west of Reading, and 70 miles from London by the Great Western Railway. It is a very neat town, and the parish church of All Saints is a handsome Gothic building containing many old monuments. It has recently been restored throughout. The town has a good trade in corn and bacon. Above 4000 pigs are slaughtered annually. There is a handsome Gothic corn exchange. In addition to the market-hall it contains an agricultural library, reading-room, and other apartments. Population, 3391. Faringdon was once the residence of the Saxon kings. Here in 925 died Edward the Elder, king of Mercia. The site of the ancient castle was granted by King John, in 1202, for a Cistercian abbey, an offspring of the wealthy foundation of Beaulieu. Faringdon House sustained a desperate siege in the Civil War. It was at one time the residence of Pye the poet-laureate.

FARM is a portion of land appropriated for cultivation either by the proprietor or by a tenant who pays for it a certain stipulated rent. The rent may consist of a share of the produce, and therefore vary with crop, which is the custom in some parts of Europe, or it may be a fixed sum of money. In England agricultural land is commonly let by the year or at will.

In no other country is the tenant farmer put in such an independent, good, and advantageous condition as in

Scotland, if he takes good heed not to engage to pay a rent beyond the productiveness of the farm. He enters on it under a lease of nineteen years, knowing that in the case of death the lease falls to his heirs. The conditions of the lease are clear and unambiguous, the farm buildings are generally in good repair, and every facility is offered for improving the land on which he enters. The rent is either a fixed sum paid twice a year, or a sum part of which is fixed and part fluctuating, according to the price of grain.

By the Agricultural Holdings Act of 1883 the tenant is entitled, under certain restrictions, to the value of any improvements made by him and unexhausted at the termination of his occupancy. If the improvements are of a permanent nature, such as the erection of buildings, &c., the consent of the landlord must have been obtained. If they consist of draining land he must be advised of them beforehand. Improvement in value due to unexhausted manures, &c., is to be determined by reference to competent persons at the termination of the tenancy. The landlord has the option of executing the two first-mentioned classes of improvements himself, and charging the tenant not more than 5 per cent. upon the outlay.

When it is decided what extent of farm may be advantageously undertaken with a given capital, the most important object to be attended to is the condition and fertility of the soil, not only with respect to the natural quality of the land, but to the actual state it is left in by the preceding system of cultivation. It will be a great advantage to have had an opportunity of seeing the land at all times, observing it in different seasons and states of the weather, and especially of seeing the crops thrashed out, and ascertaining the quantity of corn which is usually yielded from a certain quantity of straw, for lands very similar in outward appearance will produce a very different return when the crops are thrashed out. Next to the nature of the soil is to be considered the convenient situation of the farm, the disposition of the fields, and the adaptation of the farm buildings to the most profitable occupation of the land. The roads, especially those which lead to the neighbouring towns, whence manure may be obtained, are a most important consideration; and if there is water-carriage, it greatly enhances the value of the farm. The roads to the fields, and the distance from these to the farm-yard; the convenience of having good pasture, or land easily laid down in grass near the homestead; and especially the situation of the farm buildings with respect to the land, and the abundance of good water—are all circumstances which must be well considered, and which will greatly influence the probable profits, and consequently the rent which may be fairly offered.

The disposition of the buildings, in England called the *homestead*, in Scotland the *steading*, is of great importance. Large straggling buildings are inconvenient, and cost much in repairs. The house should be neat and comfortable and not too large. Near the house and the farm-yard there should be a small paved court separated from the yard by a low wall. In this court, which should communicate with the dairy, the utensils may be placed on proper benches to air and dry in the sun. The yard or yards in a large farm should be sheltered on the north side by the barns, which need not be so extensive as used formerly to be thought necessary. Every farm which is so extensive as to require more than one floor to thrash the corn on, ought always to have a thrashing-machine attached to it. A small yard, distinct from the other, with sheds for the cattle to shelter themselves under in wet and stormy weather, is a great advantage. The cart-sheds should be in the stack-yard, which properly occupies a space north of the barn. There should be a sufficient number of stands with proper pillars and frames to build stacks on. On each side of the yard should be placed the stables, cow-houses, and feeding stalls, with a pump of good water near the last, and convenient places to put hay, straw, and turnips in, with a machine to cut them. An underground cistern near the cow-house and stables, into which the urine and washings of the cow-house may run by means of a sink or drain, is a most useful appendage. The liquid manure thus collected in a tank will be found most useful in enriching the land. Light thatched roofs are sufficient for the sheds and smaller buildings, and even for the cow-houses and stables. The house should always be detached from the farm buildings, and should have a tiled or slated roof, but it is often closely attached to the dairy, as it is of the utmost importance that both buildings should be in the best position possible as regards airiness and freedom from noxious smells.

A most important question is, what may be a fair rent both to the landlord and the tenant, and one upon which great differences of opinion exist. In fact, so difficult appears the question to the best informed minds, that some of those who usually advocate the utmost freedom of contract possible in commercial matters, think that government should in a complete manner regulate the relationship of landlord and tenant, in order to fix a fair rent and to secure the tenant from the exaction of too oppressive terms in his lease. From whatever cause, however, whether from the evil effects of feudalism, as some contend, or from the fact that the competition of other countries for the supply of farm produce is rendering farming less profitable, except in very prosperous years, than manufacture, there can be little doubt that a most important and valuable branch of English industry is passing through a time of disastrous depression, if not of danger to its very existence.

The price of agricultural produce throughout Great Britain, and even Ireland, is brought very nearly to an equality, through the rapid means of transport. The price of labour still varies considerably, owing to local circumstances, but not to so great an extent as formerly.

In proportion as the management of a farm requires more skill, and the various operations become more complicated, so the necessity of great accuracy in the accounts becomes more evident. In the accounts of a farm there are many separate items to be taken into consideration. There may be a separate account kept for every field. There should always be one for every crop of which the rotation consists. There is an account of the labour of men and horses, of the produce of the dairy, of the stock purchased to be fattened or sold again in an improved state. In short, the divisions of the general account may be increased without limit.

FARMERS-GENERAL. *Fermiers-généraux* was the name given in France, under the old monarchy, to a company which farmed certain branches of the public revenue, that is to say, contracted with the government to pay into the Treasury a fixed yearly sum, taking upon itself the collection of certain taxes as an equivalent. The system of farming the taxes was an old custom of the French monarchy. The sale of salt was also a government monopoly. Sully, the able minister of Henry IV., seeing the loss to the public revenue occasioned by this system, by which, out of 150,000,000 livres paid by the people, only 80,000,000 reached the Treasury, opened the contracts for farming the taxes to public auction. By this means he greatly increased the revenue. But the practice of private contracts through favour or bribing was renewed under the following reigns. In 1728, under the regency, the various individual leases were united in a Ferme-générale, which was let to a company, the members of which were henceforth called Fermiers-généraux. In the time of Necker the company consisted of forty-four members, who paid a rent of 186,000,000 livres, and Necker calculated their profit at about 2,000,000 yearly—no very extraordinary sum, if correct. But besides this profit there were the expenses of collection, and a host of subalterns to support;

the company had its officers and accountants, receivers, collectors, &c., who, having the public force at their disposal, committed acts of injustice towards the people, especially the poorer class. The "gabelle" or sale of salt was a fruitful source of oppression. Not satisfied with obliging the people to pay for the salt at the price fixed upon it in the name of the king, they obliged every individual above eight years of age to buy a certain quantity whether wanted or not. But the rule was not alike all over France; in some provinces, which enjoyed certain privileges, it was nine livres the cwt., while in others it cost sixteen, and in some sixty-two livres. Besides, every article of provision that was exported from one province to another was subject to duties. These instances convey an idea of taxation in France previous to the Revolution. The fermiers-généraux, as the agents of that system, coming into immediate contact with the people, drew upon themselves the popular hatred. The Revolution of 1789 swept them away and put an end to the system of farming the revenues; it equalized the duties and taxes all over France; but the monopoly of the salt and tobacco remained, as well as the duties (*octroi*) on provisions, cattle, and wine brought into Paris and other large towns.

A distant likeness to the tax-farming system of France is to be traced under the earlier English kings, and is described under FERM OF THE COUNTIES. The excise duties in England, which date from the Restoration, were also farmed for some years prior to 1683.

The Roman system of levying taxes, at least after the republic had begun to acquire territory out of Italy, was by farming them out. In the later period of the republic the farmers were chosen from the equestrian order. Individuals used to form companies or associations for farming the taxes of a particular district; the taxes were let by the censors for a period of five years. These farmers were called *publicani*, and by the Greek writers *telonæ*, which is rendered "publicans" in the English version of the New Testament. These tax-collectors in the provinces were only agents. The principals generally resided at Rome, where the affairs of each association (*societas*) were managed by a director called a *magister*. The individual members held shares in the undertaking. There was also a chief manager in the province or district of which the company farmed the tax, who was called *pro-magister*. There are no means of knowing what proportion of the taxes collected reached the Roman treasury (*ærarium*). Numerous complaints of the rapacity of the publicani or their agents occur in the classical writers. These publicani were the moneyed men of the late republic and the early empire, and their aid was often required by the state for advances of money when the treasury was empty.

FARN'BOROUGH, a village of England, in the county of Hants, is situated at one of the entrances to Aldershot Camp, and has a station on the South-western line, by which it is distant from London 31 miles. It contains a number of good villas and an excellent hotel. The population in 1881 was 6266.

FARN, FEARNE, or **FERN ISLANDS,** the name of a group of seventeen islands in the German Ocean, from 1½ to 7 miles off the Northumberland coast, 8 miles S.E. of Holy Isle, and 20 miles S.E. of Berwick. There are two lighthouses upon the largest of the group, which is a rocky island, and contains a building called St. Cuthbert's Tower. This group was the scene of the wrecks of the *Forfarshire* in 1838, and the *Pégasus* five years later.

FARNE'SE, the surname of a famous Roman family who attained to great influence in Europe about the middle of the sixteenth century, through the elevation of Cardinal Alessandro Farnese to the papal chair as Paul III: in 1534. The most famous member of the family was another Alessandro Farnese, who was born in 1546. He was known as the Duke of Parma, and the title of the greatest general of his time may fairly be claimed for him. Although, perhaps with some justice, he earned the names of bravo and coxcomb in his youth, his courage was of the highest kind, and he possessed the power of gaining the affections of those under his command to a wonderful degree. His chief work was accomplished in the Netherlands, of which he was appointed governor, and where for several years he carried on the defence of the Spanish power against William the Silent and the Protestant powers with surpassing though ruthless ability. After he had held the command of the Spanish force that was gathered in the Netherlands to cross to England under the protection of the Armada, he led an expedition into France to assist the Catholic League, and by skilful strategy relieved Paris from the attacks of Henry of Navarre and the Huguenots in 1590, but being ill supported by the League and by his master Philip II. he was compelled to retreat, and lost all the advantages he had gained. While again invading France, in 1592, he died at Arras at the early age of forty-six.

The last representative of the family died in 1731, but the name is still preserved in two well-known palaces in Rome, and in two famous pieces of statuary respectively called the "Farnese Hercules" and the "Farnese Bull," which were presented by the Prince Borghese to the King of Naples.

FARN'HAM, a market-town of England, in the county of Surrey, 38 miles from London by road, and 39 miles by the South-western Railway, situated near the north-west bank of the Wey, is a well-built town of great antiquity, and one of the principal seats of the hop trade. About 1000 acres of ground are planted with hops, which have long been noted for their superior excellence. In the vicinity is Aldershot Camp, whose establishment has called into existence quite a new town on Farnham Common. The parish church is a Norman and Perpendicular building. The tower is 120 feet high. William Cobbett, a native of this town, is buried in the churchyard. There are several dissenting chapels, a free grammar-school, national school, and a handsome town-hall, with a clock-tower 88 feet high. Farnham consists of two principal streets, with a market-place at their intersection, and some smaller streets. Very pure water is conveyed by pipes from springs in the neighbouring hills to a large reservoir in the town. On the Wey are several large flour-mills. Farnham Castle is the palace of the bishops of Winchester. The original fortress was raised in 1136 by Bishop Henry of Blois, brother of king Stephen; was captured in 1216 by Louis of France, and demolished by Henry III. It was afterwards rebuilt. It owes its present form to Bishop Morley, who expended large sums of money upon its renovation, 1662–84. The ancient keep, dating from Henry III.'s time, is an interesting memorial. Waverley Abbey, the first Cistercian house founded in England (1128), lies 2 miles S.E. of Farnham. It is finely situated in a landscape rich with wood and water. The ruins are of an early English character. Moor Park, between Farnham and Waverley, was the residence of the diplomatist and man of letters, Sir William Temple, who died here in January, 1699. Dean Swift resided in it for some years as Sir William Temple's amanuensis. The population of the parish in 1881 was 11,058. Farnham means "the dwelling among the ferns."

FARN'WORTH, a rising manufacturing town of England, in the county of Lancaster, 190 miles from London by the Lancashire and Yorkshire Railway, situated on the banks of the river Irwell. It contains 9888 inhabitants. A public park was presented to the town by Mr. Barnes, then M.P. for Bolton, in 1864. The town has extensive cotton manufactures, and many of the inhabitants are employed in the neighbouring collieries. Archbishop Bancroft was born here in 1544.

FA'ROE, FEROE, or **FAROERNE ISLANDS,** a group of islands, twenty-two in number, seventeen of which are inhabited; they are 300 miles west of the coast of Norway, and about 200 north-west of the Shetland Isles, between 61° and 63° N. lat., and 8° and 6° W. lon. They were discovered between the years 858 and 868 by some Norwegians, and at present belong to Denmark. Their whole area is estimated at about 510 square miles.

These islands chiefly consist of steep rocks, some of them rising gradually from the sea, by two or more sloping terraces, covered with a thin stratum of earth only 4 or 5 inches deep, which produces grass. Close to the sea the land consists in general of perpendicular rocks, from 1200 to 1800 feet in height. The interior is composed of hills, usually separated only by narrow ravines, in which there are brooks or rivulets, generally so swollen in the rainy season as to become impassable. There are also several lakes, waterfalls, and natural springs. The climate is very bleak, and the summer lasts only through the months of July and August. In some islands there are majestic masses of basalt formation similar to the caves of Staffa. Neither the soil nor climate admits of any extended tillage. The chief kinds of cultivated plants are barley, rye, potatoes, turnips, parsnips, and carrots. Sheep, horses, and dogs are numerous, and of good growth. Whales, seals, and numerous kinds of fish and wild fowl are found among and around the islands. Turf, coal, copper, jasper, chalcedonies, and opal are met with.

The inhabitants are of Norman (or Norwegian) descent, and speak the Norwegian language with a Danish accent. They have in general handsome features and are well made. They are honest, hospitable, and simple in their manners. In most respects they resemble the Norwegians. They carry on many branches of manufacture. The five chief islands are Stromoe, 27 miles long by 7½ broad; Osteroe, 20 miles by 10; Sandoe, 13 miles by 1½; Sudoroe, 17 miles by 5½; and Vaagoe, 13 miles by 5. The chief town of the group is Thorshavn, in Stromoe.

FAR'QUHAR, GEORGE, son of a poor clergyman, was born at Londonderry in 1678, and educated at the University of Dublin. At an early age he made his appearance at the Dublin theatre, but not being successful he travelled to London, being then only seventeen years of age, and the Earl of Orrery gave him a commission in his own regiment.

In 1698 he produced his comedy of "Love and a Bottle," which was highly successful. His "Constant Couple" appeared two years afterwards, and a sequel, under the title of "Sir Harry Wildair," was also favourably received, though much inferior in merit. In 1703 he produced the "Inconstant." He was married in the same year, and getting into great difficulties was forced to sell his commission. He soon after fell into a decline, and died in 1707. He produced the "Twin Rivals" in 1705, the "Recruiting Officer" (with Sergeant Kite) in 1706, and his masterpiece, the "Beaux' Stratagem," in 1707, written in six weeks when he was dying.

FAR'RANT, RICHARD, an Elizabethan musician whose works yet delight us, was one of the gentlemen of the great queen's chapel. He died in middle age, in 1580. His anthems, "Call to remembrance," "Hide not thou thy face," and the exquisitely beautiful "Lord, for thy tender mercies' sake," are among the most favourite pieces of our church music.

FARSISTAN' or **FARS** (the ancient *Persis*), a province of Persia, is bounded on the S.W. by the Persian Gulf, and inclosed on other sides by the provinces of Khuzistan, Irak-Ajemi, Kerman, and Luristan. On the coast the surface is level and the climate hot; but in the interior are mountain ranges, interspersed with many long and narrow fertile plains. The central mountain chain divides the rivers into those which flow into the Persian Gulf and those discharging themselves into Lake Bakhtegan. The chief of the former is the Tab, the ancient *Arosis*, and of the latter the Bendemeer, or rather Bundemeer, the ancient *Cyrus* or *Araxes*.

Besides the Lake Bakhtegan, which is 70 miles in circuit, there are several other lakes, the chief of which is in the neighbourhood of Shiraz. These as well as some of the rivers are salt, and the bed of the Lake Bakhtegan yields in summer, when it is nearly dry, great quantities of this mineral. The products comprise corn, rice, dates, raisins, and other fruits, opium, tobacco, saffron, hemp, cotton, silk, attar of roses, and wine. Many cattle and sheep are reared; and the horses, camels, and asses are of superior breeds. The minerals found here are lead, iron, marble, borax, naphtha, and salt. The chief manufactures are of silk, woollen, and cotton stuffs, and skins, for exportation. The area is 53,125 square miles. The province contains the ruins of Persepolis, Pasarga, and Shakpur. Farsistan was the ancient patrimony and kingdom of Cyrus the Great previous to his foundation of the Persian Empire.

FAR'THINGALE or **VAR'DINGALE,** probably a corruption of the French *vertu-garde* or virtue guard, a hoop of whalebone formerly worn by ladies to spread the petticoat to a wide circumference. It afforded the ladies a great opportunity of displaying their jewels and other ornaments to the utmost advantage, and for that reason obtained the superiority over the closer-fitting habits. The hoop, the last remains of the farthingale in England, went out at the beginning of the reign of George IV., but reappeared in the reign of Queen Victoria, in the form of the so-called crinoline, which imitated the puffed haircloth petticoat (*crinoline*) by a series of hoops of thin steel.

FAS'CES, among the Romans, a term applied to the bundle of rods bound round an axe, of which the iron head protruded, and which the lictors carried before the chief magistrates. The axe and the bundle of rods were intended to represent, first, the emblem of punishment; and secondly, the power of unanimity among the citizens. The fasces were first introduced by Tarquin as a mark of sovereign authority, and afterwards adopted by the consuls.

FAS'CIA (Latin, a bandage or ligament), a term of very general use in anatomy, and applied to any aponeurotic expansion of muscular fibre by which certain parts are brought together, such as the *iliac fascia*, which covers the inner surface of the iliac and proas muscles, &c.

In classical antiquity the fascia was a thin sash, frequently mentioned by Latin writers, which the Roman ladies wrapt round their bodies next to the skin, for the purpose of giving a slenderness to the waist.

In architecture the fascia is a broad fillet or band, sometimes used alone and sometimes in combination with the mouldings of the architrave or imposts. It sometimes happens that two or three fasciæ, according to the taste of the designer, constitute the different divisions of the architrave, each of which projects slightly beyond that which is directly below. In ordinary building it is applied to the flat surface of the great beam or bressemer along a shop front, whereon the shopkeeper usually writes his name or his trade, or both, in large letters.

In astronomy the term fascia is applied to the belt across a planet, as the fasciæ or belts of the planet Jupiter.

FAS'CICLE, in botany, is, strictly speaking, that kind of inflorescence in which the flowers are arranged in a flat-headed raceme or corymb, and begin to expand in the centre sooner than at the circumference. The term is, however, constantly applied to any collection of flowers or leaves in clusters at the end or on the sides of a branch; thus the leaves of the larch are called fasciculate. The term is derived from the Latin *fasciculus*, a small bundle.

FASCINES are bundles of strong brushwood, branches of trees, or osiers, bound together with yarn or withs. They are used for military purposes, in the construction of

temporary works; for filling ditches, making roads over marshy ground, covering roofs of field-magazines, and sometimes for setting fire to an obstruction. They are about 10 inches in diameter, and of various lengths, from 5 to 20 feet, according to the object for which they are intended. A fascine of the longest kind is sometimes called a saucisson.

FASHION is the name given to the general habit of society for the time being in dress, pursuits of pleasure (and even of business), studies, speech, &c.

Of all fashions the most changeable and capricious is the fashion of dress. A fashion for antique furniture, for blue china, for collecting old postage stamps, for etchings as against engravings (or *vice versâ*), for red-brick houses, for dark rooms, for particular authors, and especially for particular artists of every sort, may set in without rhyme or reason, and after lasting its time, will disappear in an equally unreasonable manner. But the swiftness and absurd unreasonableness of the changes in dress, most commonly changes for changing's sake, are far beyond all others; and the costume of the hour is what is always taken to be meant by *the fashion*, without any further qualification. Only a few years since many honourable firms were brought to ruin, and numbers of worthy artisans were on the brink of starvation in the town of Coventry, because the fashion, after running on ribbons to a great height, suddenly veered in another direction, and all who made or sold ribbons were left destitute. Hazlitt well says that "fashion constantly begins and ends in two things it abhors most—singularity and vulgarity. It is the perpetual setting up and then disowning a certain standard of taste, elegance, and refinement, which has no other formation or authority than that it is the prevailing distraction of the moment; which was yesterday ridiculous from its being new, and to-morrow will be odious from its being common." It is valuable, therefore, as well as interesting to make a brief survey of the principal changes of costume in England, avoiding details wherever possible, since the subject is practically inexhaustible. Planché's "Cyclopædia of Costume" (two vols. 4to, London, 1879) hardly does more than give a tolerable survey of the ground; though it is a great improvement on Fairholt's "Costume in England" (London, 1860, second edition), and is the best authority on the subject at present.

The Britons, to begin at the beginning, were, like the Gauls, a *gens braccata*, a people with breeches, as opposed to the *gens togata*, or (trouserless) people with cloaks—*i.e.* the Greeks and Romans. Breeches and barbarism went together in Roman eyes, very oddly in our modern view. The dress of men and women differed very slightly, as shown on monuments and medals; perhaps the chief difference is in the men wearing hats and the women trusting only to their long hair as a protection to the head. The dress was a blouse with sleeves, confined in some cases by a belt, trousers fitting close at the ankle, and a tartan plaid fastened at the shoulder with a brooch. The chieftains wore their hair in a long mane, or those who were less particular cut it in a thick shock low on the forehead. The hair and moustaches were dyed red with gallic soap, made of goats' fat and the ashes of beechen logs (Elton, "Origins of English History," London, 1882).

Afterwards, when the country was thoroughly a Roman colony, the better classes of Britons adopted the woollen Roman toga for the men, and the Roman outer and inner tunics for the women; the men, however, still retaining the national breeches.

The English conquest brought the linen undershirt with it, and often a coarse linen tunic or outer shirt as well, the latter surviving in the rapidly disappearing "smock-frock" of our carters and waggoners with its patterns of ancient cross-worked embroidery on the shoulders, &c., no doubt unchanged for ages. The same crossed designs were carried out by the early English in the cross-gartering of the hose and lacing of the open leather shoes. The nobles wore a woollen cloak fastened by a brooch at the neck, a woollen tunic, and a linen shirt. The whole costume is excellently portrayed in the coloured Plates illustrating the BAYEUX TAPESTRY.

If the English had brought body linen, the Normans brought gloves as an additional article of costume. At first they were only marks of nobility, and were richly jewelled on the back (see the effigy of King John at Worcester Cathedral). Under King John hooded cloaks were often worn, but other headgear, except a fillet round the elaborately curled locks, was unusual. It was considered to conceal the hair too much. The face was shaven, and the back of the head also, under the earlier Norman kings. The ladies of the Angevin dynasty wore long gowns covering the feet, girdled at the waist, whence a purse or pouch hung down, and high in the neck, with long tight sleeves to the wrist; the hair was bound with a jewelled fillet, and covered with a wimple or veil. By the beginning of the fifteenth century (Richard II. and Henry IV.) dress had risen to an extraordinary pitch of absurdity: mantles, hoods, &c., had their edges cut into leaves and other patterns, and the dresses were covered with mottoes and heraldic devices embroidered in a costly way. Richard had one coat which was valued at 30,000 marks. The long wide sleeves of the tunic, with their fantastic edges, reached to the feet, the hood was extended into a long pipe-like prolongation (liripipes), often nearly touching the ground; the shoes had long points at the toes, curled upwards and fastened to the knees with chains of gold or silver; elderly lords dressed in long gowns to the feet. Ladies' dress was the low-bodied kirtle, fitting very tight, with a large loose sleeveless gown, trimmed with fur at the edges, worn over it. A peculiar sideless kirtle, showing at each side the under dress, and called the "cote hardi," retained its favour for two centuries. The hair was confined by a gold caul or fret of network surmounted by a chaplet, or a coronet in the case of noble ladies. Under Henry VI. this changed to an extravagantly high and projecting horned head-dress, sometimes straight, sometimes heart-shaped; and this became contracted under Edward IV. into the "steeple" head-dress, made of a roll of linen much such as Norman nurses wear at the present day in a reduced form, and carrying a long veil which hung in folds to the ground. The common people at this time wore—the men, a woollen tunic girdled at the waist, with sleeves following the shape of the arm, pointed boots, and a cap the lining of which fell on one side over the head; the women, an upper and under kirtle, with a framed head-dress giving a distant resemblance to the well-known fazzoletta of the Neapolitans. The close of this period (Edward IV.) presented a remarkable dress among the noblemen. A short jacket was worn, drawn in at the waist, and extending only an inch or two below that, padded out at the shoulders, the sleeves slit up the back or across the elbow to show the white shirt (a fashion of "slashing" which lasted for many generations, and was widely extended afterwards); the hose fitted tightly to the figure, somewhat too liberally displayed by the short jacket, and the hat was almost as tall as the steeple head-dress of the ladies. Long pointed toes to the boots were worn. These extravagances were in vain sought to be controlled by legislation both in the third and twenty-second years of Edward IV.

The Tudor dress is well known by the many portraits of "bluff King Hal," the velvet bonnet on one side of the head, the large feather surrounding it, the slashed sleeves and trunk-hose swelling out monstrously from the tight hose on the thighs, the broad-toed shoes, the sleeveless short cloak, through which the arms are thrust, &c. The ladies' dress was cut square, and the opening filled in with an embroidered habit-shirt. Catharine of Aragon wears a

"diamond" head-dress, roofing in the face as with a gable, in her best known portrait, but this was a Henry VII. type. Their dainty cap and feather of Henry VIII.'s reign is one of the prettiest ladies' head-dresses ever invented (see Holbein's portrait of Anne Boleyn). About 1560 ruffs of frilled starched linen round the neck began to come into fashion for both men and women of rank. Cathérine de Medicis has the credit of introducing them into France. We find Sir Walter Raleigh (time of Elizabeth), in a celebrated portrait, dressed in a white satin-pinked vest, close-sleeved to the wrist, and with a fluted ruff round the neck; and over the body a doublet finely flowered and embroidered with pearls, in the feather of his hat (hats now replacing the flat bonnet) a large ruby, and a pearl drop at the bottom of the sprig in place of a button. His breeches and stockings were of white silk, and even his shoes with jewels in them worth £6500 on court days, &c. The costume of Elizabeth's ladies was equally splendid: the long pointed waist and gorgeously ornamented stomacher, the broad ruff delicately embroidered and rising high behind the head, and the ample farthingale are familiar to all. It is curious to remark how closely one sex copied the other at this period.

The Stuarts, as became their French and Spanish relationships, modified the costume in that direction. Under James I. the long-waisted peaked doublet of the Elizabethans became longer, closer, more peaked than before, and men wore stays to get them to fit the better. The trunk-hose stood out from the hips like a balloon, and then tapered down to the knees, where bows secured them. Pointed velvet hats, with a small feather fastened by a jewel on one side, and a narrow brim were worn. The ladies discarded the modest habit-shirt while keeping the low-cut bodice, the farthingale (vertu-garde) quite disappeared by the close of James I.'s reign, and patches began to be worn. The tasteless male costume of James changed gradually into the exceedingly handsome Charles I. dress, so nobly familiar to us in the Vandyke portraits. The coat, often of velvet, opened in front to show the rich shirt below, and was buttoned above as it met the collar of lace; the sleeves, fastened at the wrist, were covered with lace or white cuffs. The trunk-hose gave way to loose open breeches, fringed or lace-edged. The well-fitting hose were terminated by shoes with rosettes. The meanly shaped hat was driven out by a broad-brimmed felt hat of beautiful design, beneath which the flowing hair fell on the shoulders. Probably this costume, in the less foppish examples, is the most elegant that Englishmen have ever worn. The Puritans of this time cut close the hair (whence their name Roundheads), used plain bands for lace, narrowed the breeches and discarded the ribbons, &c., and their dress, though plain, was serviceable and not inelegant. Charles II. brought in the costume of Louis XIV. for the court, Puritan ways still continuing elsewhere. A short-sleeved loose garment, progenitor of our modern coat, had beneath it a sleeveless vest, ancestor of our waistcoat. The shirt sleeves bulged out at the elbows, tied with ribbons. The hat was cut low in the crown, and the natural curls were replaced by monstrous periwigs. A profusion of lace and ribbons, buttons and trimmings covered this parody of the "Vandyke" dress, which was as gaudy in its general colour as its predecessor had been stately and refined. In an inventory of 1679 we find the terms coat, waistcoat, breeches, and stockings (replacing the former long hose); and we may consider that our modern costume has begun. By William III.'s reign the "petticoat breeches" had shrunk so as to fit the leg, and "knee-breeches" had begun their long career; the coat, now long and skirted, fitted the body, and had large pockets, and the waistcoat became so long that the lower buttons were not fastened. The ladies' dress of Charles II.'s court was neither modest nor graceful; the bosom was indelicately exposed, the arms bare; the face, with its row of short curls on the forehead, seems to acquire a boldness of expression foreign to English notions. This is the costume of Lely's "beauties," familiar on the walls of Hampton Court; and it is something to be rejoiced over that with the Stuarts it passed away. The fan with a hole in it for wear at the theatres sufficiently marks the low ebb of female modesty at this disgraceful time. See FAN.

Under the house of Hanover the costume of men changed to one much nearer our own. The coat and waistcoat were more ample than is now worn, the trousers did not yet exist; still the important difference from a court suit of the present day is chiefly to be found in the use of hair powder or close-cut wigs (the long curls having disappeared), and in the universal adoption of the three-cornered hat or "cocked hat." This is the costume of Pope, and the snuff-box and the clouded cane, the ruffles at the wrist, and the hair gathered under a bow of ribbon into a short queue, pervade his poetry as in an atmosphere of their own. The coats were often of velvet and of the most brilliant hues, much such as the footmen of the present day still wear. Poor Goldsmith's plum-colour coat has earned him an immortality of jesting, while Dr. Johnson's snuff-brown cloth is part and parcel of the sturdy old man. The ladies of the time wore hoops of hideous shape and large size. The dress usually bore a broad loose fold down the back from neck to hem, called a sacque. Powdered, patched, and painted, Pope has satirized them in lines that live for ever.

But the French Revolution drew near, and the liberal ideas of which it was the violent outcome permeated all the society of civilized Europe, even to its fashions. The three-cornered hat became a round one, its feather vanishing for ever; the coat and waistcoat, now universally of quiet coloured cloth, shrank almost to modern size; the knee-breeches gave way frequently to pantaloons, following the shape of the leg; while wigs and hair powder disappeared. Roland, minister of France, ventured to appear at court without buckles to his shoes—with a mere shoe-string indeed; plainly showing to a certain courtier whose horror has amused the world ever since, that the end of all things was at hand.

Finally, about 1815, the trouser displaced the knee-breeches (except in court dress and for menials), and though peculiarities, as of wearing many waistcoats (or of many collars of waistcoats), of enwrapping the neck in the voluminous folds of a stock, &c., appeared from time to time, the costume of men has not varied in any important particular since. The curl of a hat, the tightness or looseness of a trouser leg, are the petty varieties we study and date by. Sportsmen and those who play athletic games, or who ride on bicycles, favour the knickerbocker and tight stocking, and thus return in some sort to earlier ways. Ladies' dress has varied so frequently and so violently in the present century that it would require a long article to detail the changes. In the earlier years feathers nodded over the high-piled hair, the waist was under the armpits, whence a scanty petticoat descended to a narrow frill, hardly giving room for the feet to take a step of even moderate length; the sleeves, quite short at the shoulders and puffed out immoderately, made the lady seem almost humpbacked, and long gloves reached above the elbow. Towards the middle of the century (countless changes having intervened, an attempt at adopting male costume made by Mrs. Bloomer, among them) the disfiguring hoop reappeared, vaster than ever, and made now of bands of steel, which breaking sometimes pierced the wearer, and which still more often caused the dress to catch fire and the unfortunate victim to lose her life. Bonnets varied from the spoon-bonnet, with a large bouquet as big as the face under a pointed arch-like front above the head, to a tiny cap-like garment nearly invisible. These extravagances were largely due to the vicious and debased court of the

lower French empire under Napoleon III. Later on a determined attempt was made against the pinched waists of that time, the low-necked dresses, the high-heeled shoes, the great weight of garments slung on to the hips, &c., by Dr. Mary Walker, Dr. Garret Anderson, and other ladies. Dr. Walker's modified Bloomer costume was not greatly adopted, but the use of easy stays, or of no stays at all, of broad and thick-soled boots, of suspenders or braces taking their support from the shoulders, and of such mysteries as the "divided skirt," &c., became very common indeed with sensible ladies towards the latter part of the century. Probably the rapidly increasing number of women-doctors and women-scientists was the cause of this wholesome reform. But how long it may last no man must be rash enough to predict.

FAST and **FASTING**, abstinence from food, more particularly used for such abstinence as a religious observance (from the Anglo-Saxon *fæstan*). Religious fasting has been practised in almost all ages and all countries. It has been generally observed in its most severe forms in Eastern countries. The Jews, however, had but one fast enjoined as compulsory by the Mosaic law. This was the Day of Atonement, or the Sabbath of Sabbaths, observed on the tenth day of the seventh month. As time went on numerous other fast days were added, commemorating the many bitter times of suffering and humiliation which fell so heavily on the Jewish nation. Mohammed recommended fasting to his followers as a wholesome practice, and they are commanded by the Koran to fast from daybreak to the rising of the stars during the whole month of Ramadan, but the prohibition does not extend to the night of that period. As regards the amount of obligation of fasting existing for Christians, the subject has been fertile in disputes, the references to it in the Gospels having been resolutely claimed by the supporters of opposite opinions as teaching exactly opposite precepts. After the evangelists and apostolic writers the first direct mention of fasting as a duty occurs at the end of the second century, and it was not until the sixth century that days for fasting are known formally to have been set apart. Whether voluntarily or by command, fasts on Friday as the day of the crucifixion, and on Wednesday as the day on which the death of Christ was decided on, seem to have been very early observed. About the fourth century vigils were converted into fast days kept on the eve of great festivals, owing to the evils that had arisen from the night services previously called by that name.

The Church of Rome now imposes a certain number of fasts on her members, which chiefly involve an abstinence from meat of every kind. The Greek Church also imposes a large number of fasts, and has always carried them out with great severity. The Church of England leaves both the option of fasting and the method to the conscience of individual members. The fixed days appointed by it are —the forty days in Lent; the Ember Days at the four seasons, being the Wednesdays, Fridays, and Saturdays after the first Sunday in Lent, the Feast of Pentecost, the 14th September, and the 13th December; the three Rogation Days, being the Monday, Tuesday, and Wednesday before Holy Thursday; and all the Fridays in the year except Christmas Day. In Scotland fast days are held twice a year in connection with the dispensation of the sacrament of the Lord's Supper. Business is suspended during the day in the parish in which the fast is held.

Probably the natural disinclination for food which commonly accompanies any great sorrow has had a large share in making fasting one of the accepted outward signs of mourning. The facts also that long abstinence from food tends to produce delirium and ecstasy, and exhibits a great amount of self-control, would naturally tend to the extension of the practice by those who desired to earn a reputation for sanctity or supernatural powers. The very circumstance that this really involved a true virtue—self-control—would lend a basis for genuine respect for the fasters. In modern times there have been many cases of reported extraordinary long abstention from food, but most of these, after having brought considerable profit to their manipulators, and misery and probably life-long suffering to the subject, have generally proved to be wilful impostures. A very small regular allowance of food or water, even when the latter is applied externally, will maintain life in a feeble state for a long time, and it is greatly owing to this that cases of imposture are possible. The best authenticated case of fasting in modern times is that of Dr. Tanner, an "eclectic" physician of New York, who fasted forty days and nights, viz. from 28th June to 7th August, 1880. During the time he drank 667½ ounces of water, and lost 36 lbs. in weight. His weight at starting was 157½ lbs.

FAS'TI were marble tables at Rome, on which were inscribed the names of the consuls, dictators, censors, and other principal magistrates of the republic. Fragments of these tables have been collected, and are ranged along the walls of one of the halls in the palace of the Conservatori on the Capitol. The deficiencies in the series of the consuls have been supplied by means of the historians, and by consulting monumental inscriptions. Several learned men in modern times have compiled Fasti, or chronological tables of the Roman consuls. The word fasti is often used as synonymous with the annals or chronicles of a nation.

The Romans had another kind of fasti, a kind of almanack, in which were registered the periodical festivals, games, official days for business, &c. The *dies fasti* were the days when the law-courts were open and it was allowable to plead (*fari*); holidays were *dies nefasti*. Ovid wrote a poem explanatory of these fasti, which he dedicated to Germanicus, and in which he described the origin of the festivals, and the recollections, either happy or calamitous, connected with the various days of each month. The poem as we have it, is in six books, one for each of the first six months of the year; the rest is lost. These indeed are the original lists, and the historical *fasti* derive their name from their resemblance to the calendar just described. As the irregularities of the old Roman calendar made it very difficult for anyone but a priest to know when the dies fasti would fall (because of the necessary interpolations to bring the ill-adjusted months into order), the common people were for a long time at the mercy of those who had access to these calculations. Under the decemvirate a clerk published the list copied from that of the priests, and afterwards it became a general practice to publish these lists. They eventually grew into a sort of calendar.

FASTIG'IUM, in architecture, is the Latin name for that triangular gable-end of buildings in the style of the Greek temple which we call "pediment." When the Romans began to bestow divine honours upon Julius Cæsar (during his life), they decreed him the privilege, among other things, of being at liberty to erect a fastigium over the columns of his house-porch; that is to say, they permitted him, if he chose, to make his house apparently the temple of a god.

FAT is both of animal and vegetable origin. Fats are either liquid or solid, in the former case being called fatty oils, and in the latter solid fats. Some of the oils are called fixed, others drying oils; the former remain greasy when dropped on paper, as almond-oil, the latter dry up, as linseed-oil; lard, tallow, and wax are examples of solid fats. Some of these are beautifully crystalline, as cholesterin and spermaceti. They vary in consistence from the thinnest olive-oil to the most compact suet, this variation being caused by the variable proportions in which the solid and fluid fatty principles are associated in the product. They are made up of two or three distinct substances easily separable from each other. Olive-oil exposed

to a temperature of 40° Fahr. deposits a crystalline solid fat termed *margarin*. The portion from which this is separated is denominated *olein;* while in animal fat a third substance is found associated with margarin, which has received the name of *stearin*. The olein and margarin of all vegetable and animal oils are not, however, identical; it is even possible that there may be essential differences between them. See OIL.

Human fat varies a little according to the part of the body producing it; that from the region of the kidneys, after it has been melted, is yellowish and inodorous; it begins to congeal at 76° Fahr., and is solid at 64°. The olein of human fat is a colourless, oily, sweetish fluid, and remains so at 40°; at 60° its specific gravity is 0·913. *Ox fat*, when melted, begins to solidify at 98°, and the temperature then rises to 102°. It contains about three-fourths of its weight of stearin, which is solid, hard, colourless, not greasy, and of a granular crystalline texture. The olein of ox fat is colourless, nearly inodorous, and its specific gravity is 0·913. *Sheep's fat*, or mutton suet, by exposure to the air acquires a peculiar odour. After fusion it congeals at a temperature varying between 98° and 102°. The stearin is white, translucent, and after fusion but imperfectly crystalline. *Hog's fat*, or hog's lard, is a soft colourless solid, which fuses between 78° and 86°; the stearin of hog's lard is inodorous, solid, and granular. *Goat's fat* contains a peculiar fat, termed by Chevreul *hircin*, to the presence of which its peculiar odour is owing. *Goose fat* is colourless, and of a peculiar taste and smell.

The olein and stearin of animal fats are highly useful and important substances in the manufacture of soap and candles; for the latter purpose stearin has been of late very advantageously employed, and to a considerable extent as a substitute for wax. Saponification is effected by bringing fixed fatty bodies into contact with alkaline solutions at a high temperature. A viscid homogeneous mass is produced by their combination, which is freely soluble in warm water, but insoluble in saline solutions. By this process the fatty elements are completely changed, and the stearin, the olein, and the margarin give respectively stearic, oleic, and margaric acids, accompanied by a peculiar sweet substance termed *glycerin*, which is colourless and uncrystallizable. The fats can be reconstituted by the combination of these bodies. See SOAP.

The origin of fat in the animal body was at one time the subject of much animated discussion. Some maintained that starch and saccharine substances were converted into fat by the separation of carbon and oxygen, as in vinous fermentation; while others contended that oily or fatty matter is always present in the food, and is merely absorbed and deposited. By a series of interesting experiments by M. Dumas and Mr. Milne Edwards, the former of these views has been confirmed, and it has been shown that bees exclusively feeding on sugar are still capable of producing wax, which is known to be a true fat.

The following analysis of the stearin and olein of mutton suet may be taken as examples of the general composition of these substances:—

	Stearin.	Olein.
Hydrogen,	11·770	11·090
Carbon,	78·776	79·354
Oxygen,	9·454	9·556
	100·000	100·000

They are distinguished from the hydrocarbons by saponification with alkalies and by containing oxygen.

FAT (as food) is valuable as a heat-producer; lean is both a heat-producer and a flesh-former. Fat cannot produce muscle, because it contains no nitrogen. In 100 parts it has 77 of carbon, 11 of oxygen, and 12 of hydrogen. In the body these elements recombine, the carbon taking up oxygen and forming carbonic acid, the hydrogen taking the rest of the oxygen as well as some from the air in the lungs and becoming water. It is estimated that at least a third of the weight of the carcass of meat as prepared by the butcher is fat, and in fat sheep nearly one-half. This fat is mixed with the lean in the general structure of the body; but also it exists in great masses within the loins, around the kidneys, &c., and is cut off and sold separately from the meat as suet. Suet is unusually solid, has hardly any distinct meaty flavour, and is therefore exactly fitted for culinary combinations with flour, as puddings, &c.

Fat is valuable in many ways in the digestive economy. It is more readily transformed than starch, also a great heat-producer; it is a lubricant, aiding the process of the food; it adds an agreeable flavour to bread and farinaceous food, and renders them palatable. It is found that the bowels act more freely when a fair quantity of fat forms part of the dietary. The composition of suet is tolerably uniform, but there is more stearin and less olein in mutton than in beef suet. There are 4760 grains of carbon in a pound, or reckoning free hydrogen as carbon 6720 grains. The preparation from pig's fat called LARD is elsewhere spoken of.

Fat is a valuable preservative of organic matters when pure. Everyone knows the sardines in oil of our breakfast table, which keep good for a long time; and potted meats with their coating of butter give another familiar example. Several successful methods exist for preserving meat by coating it with fat, but other methods of preservation, though not more efficient, are found more economical. The fat is not readily usable after serving its purpose, but that is a detail which the progress of discovery may remedy.

Vegetable fats are now beginning to supply us with food. These are chiefly from the palm trees of Eastern countries, and the butter-nut and Shea butter of Africa. In the gloomy forests of Central Africa, where milk and butter are, scarcely attainable, and in the great mangrove swamps where the cassava, plantain, and yam are the chief foods, palm-oil and vegetable fats are almost necessaries of life.

Fat as stored-up tissue in the body serves the following uses:—It is a store of combustible or heat-producing material usable as occasion requires; it prevents the escape of heat from the body, lining the skin as it usually does in nearly every part—and this is so valuable a function that fat or oil is often rubbed into chilly persons for this purpose, or swimmers who remain long in the water are anointed with it; it forms a soft cushion for tender structures to lie on, or soft wrappings to surround them; thus in starvation the fat supporting the eye is the last fat to disappear; and finally, it fills the long bones as a yellow marrow, supporting the nutrient bloodvessels.

FA'TA MORGA'NA, a name given to a very striking optical illusion, reflecting images of men, ships, and buildings, which has been principally remarked in the Straits of Messina, between the coasts of Sicily and Calabria. The phenomenon is accounted for by the refractions of light in the air above the surface of the sea, that air being at times more rare and at other times more dense than the air over the land. [See MIRAGE.] Fata Morgana means the Fairy Morgana, as the illusion was believed to be an elfish trick of hers, in the spirit of the Queen Mab of Shakspeare.

FATE, FATALISM (Lat. *fatalis*, of or belonging to destiny), express a conception of the universe which maintains that everything happens in obedience to an irresistible influence or preordination. With respect to man it implies that every human being from the cradle to the grave is under the influence of an unseen power, by which the details, acts, and thoughts of his life have been prearranged, and that his supposed power of will and choice is in reality a delusion. This notion can be traced back to the earliest dawn of history. It has prevailed to a greater or lesser

degree in connection with most systems of religion, and it has been maintained by several of the schools of philosophy. For the Greek conception see FATES.

In Christianity it appears in the doctrine of predestination formulated by Augustine and reproduced by Calvin. See CALVINISM and PREDESTINATION.

The doctrine of fate forms an essential part of the Mohammedan creed, and submission to the will of God, by whom all things are decreed, is the highest duty of the true believer.

FATES, THE. The dread goddesses who watch the operation of universal law; in the Greek mythology, everything, even the gods themselves, must obey their unalterable decree. Hesiod describes them as three in number: *Clotho*, who prepares the thread of destiny; *Lachesis*, who spins it, assigning to every man his lot; and *Atropos*, who cuts the thread when its length as allotted has been reached.

"Then comes the fury with th' abhorred shears,
And slits the thin-spun life."

The Fates assign to the FURIES their functions as avengers; as for themselves they move not from their awful task. The Greek name for the Fates was Moiræ, the Latin name Parcæ; they were children of Erebus and Night, or of Ananke (Necessity). Homer speaks of Fate in the singular as a personified abstraction (*Moira*); once only (Il. xxiv. 29) he uses the plural form.

In the Norse mythology the three Norns fill the part of the Fates. They watch the past, the present, and the future. The Norns specially watched over springs of water, perhaps symbolizing the welling forth of life from an unknown source. As with the Greek Fates the decrees of the mysterious Norns were irrevocable. Often in Norse legends two Norns give favourable message, and the third prophesies evil. Here again the dismal function of Atropos is shadowed forth.

FATHER-LASHER (*Cottus bubalis*), a fish belonging to the genus Cottus (BULL-HEAD). It is a marine species common on British coasts, and ranging across the Atlantic to the coasts of America. The armature of the head is more developed than in the other two common British species, the river bull-head and the sea scorpion, the spines being longer in proportion. The lateral line is armed with bony plates. The father-lasher feeds on crustaceans and the fry of fishes. In colour it is brown above and curiously mottled and spotted beneath. Its appearance is very repulsive. Scotch fishermen call it the *proach*.

FATHERS OF THE CHURCH is the name given to those teachers of the church who expounded the orthodox faith, or defended it against heathens or heretics, from the times of the apostles to that of the schoolmen. Among the Jews, previous to the rise of Christianity, the well-recognized ideas of parental authority and supremacy which prevailed had given to the term father a variety of secondary significations. Thus we find in the Old Testament it is applied to prophets, to priests, and to kings, while in the New Testament it is used in the sense of seniors, and is claimed in a symbolic sense by the apostle Paul (Judg. xvii. 10; 2 Kings ii. 12; 2 Kings v. 13; Acts vii. 2; 1 Cor. iv. 15). During the early ages of Christianity the title was applied very freely to the ministers of the church—confessors, instructors, the heads of monasteries, bishops, and all writers who obtained distinction by their learning and piety being designated father.

In the course of time, however, the title of father of the church was reserved for those who, by their written and oral teaching, had defined or expounded Christian doctrine in an orthodox manner, and had materially assisted in its formulation and development.

There have been many controversies as to the duration of the patristic period, for while most authorities commence it with those writers who were contemporary with the apostles, there is a great divergence of opinion as to when it terminated. Some historians make the seventh century the closing period, while others speak of St. Bernard, who died 1153, as the last of the fathers, and the list of the Greek Church extends to a period still later. The shortest period mentioned is perhaps that which is most generally accepted.

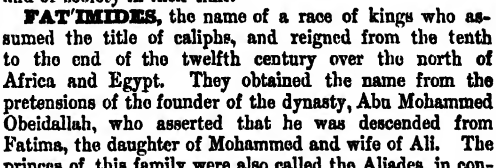
The list of those who are properly entitled to be regarded as fathers of the church has never been very accurately defined, and the position they occupy with regard to Christian doctrine is very differently estimated by both Catholic and Protestant theologians. Notices of the most eminent of the fathers are given under their respective names, and the reader is referred to the articles ATHANASIUS, BASIL, CHRYSOSTOM, and GREGORY NAZIANZENE, the most illustrious fathers of the Eastern Church, and to AMBROSE, AUGUSTINE, GREGORY, and JEROME for those of the Western.

With regard to the authoritative character of the teachings of the fathers, the Roman Catholic Church claims that where unanimity concerning any point is found in their writings, this must be accepted as the doctrine of the church, but no stress is laid upon the personal opinions or peculiarities of any one of them. In the reformed churches, as a rule, there is less respect for the patristic writings, and most of their theologians appeal to the Scriptures directly, in the spirit of the sixth article of the Church of England. At the same time most Protestant writers would be disposed to admit, that where the earlier fathers can be shown to be substantially of one opinion, the point in question is in all probability one that has been accepted in the church from apostolic times. In the absence of anything to the contrary, such testimony must have great weight as evidence of original apostolic institutions. Even in those cases where differences of opinion are manifest, the utterances of the fathers are worthy of careful attention, seeing they are the words of good men who had earned the respect and esteem of their fellow-Christians during times of trial and difficulty. Further, the study of the fathers is interesting not only to theologians, but to all those who would examine carefully the state of philosophy and of society in their time.

FAT'IMIDES, the name of a race of kings who assumed the title of caliphs, and reigned from the tenth to the end of the twelfth century over the north of Africa and Egypt. They obtained the name from the pretensions of the founder of the dynasty, Abu Mohammed Obeidallah, who asserted that he was descended from Fatima, the daughter of Mohammed and wife of Ali. The princes of this family were also called the Aliades, in consequence of their descent, real or pretended, from Ali.

FAULTS are cases of discontinuity or rents in rocks, in which one side has been pushed up or has sunk down. Thus in fig. 1 the beds marked A and *a* are parts of

Fig. 1.

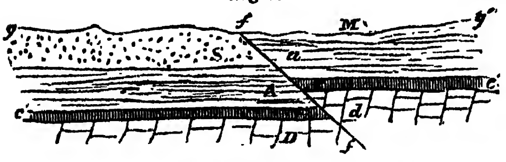


the same stratum, so are those marked B and *b*, C and *c*, D and *d*. But the part A on the left of the line of fault *f f* is at a lower level than the part *a*, and all the beds on the left have sunk below the corresponding ones on the right, though they preserve the same order, and after A and *a* (the latter not having been protected from denudation) the same thickness. The bed *a* has been overlaid by a continuation of the bed S, which has been planed away by denudation, the portion of this bed on the left of the

line having been preserved to a certain extent on account of the protection afforded by the once higher ground on the right of the fault line. The figure represents a section of the faulted strata; an observer on the surface of the ground ($g\ g'$) would discover the fault by finding different rocks, s and a, on either side of a line in which f is a point, unless the line in question happened to coincide with the strike of the rocks, a case which will be considered further on. Frequently a belt of broken rock, called *fault rock*, occurs on both sides of the fault, an evidence of the disturbance which attended the fracture; occasionally, too, the ends of the strata abutting against the fault line are bent upwards or downwards.

The inclination or *hade* of a fault is measured from the vertical. Thus in the figure, the angle C c N represents the inclinations; if this angle be 50°, we should say that the fault hades at an angle of 50°. The throw, or amount of vertical displacement, of the fault is shown by the line c N, the lateral displacement (the amount of which obviously depends entirely on the angle of hade) by the line C N. The sunken side (the left in the figure) is known as the *downthrow* side, the higher side is the *upthrow*. In most cases (as in the figure) faults slope away from the risen side, that is, they hade in the direction of the downthrow. The importance of this rule is obvious if we suppose C c to be a bed of coal, for instance; for in this case the direction of the hade would warn the miner to go downwards when he got to c, or upwards if he were at C. Sometimes, however, "reversed faults" are met with (see fig. 2), the hade

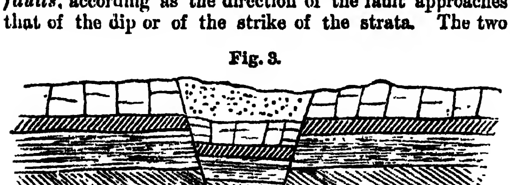
Fig. 2.



in these cases being towards the upthrow. A fault of this description may happen to be useful, for a vertical shaft sunk about M would pierce the seam twice. But miners working from c' to c would, if they did not know the fault to be a reversed one, on reaching c go upwards, or on reaching C would go downwards had they been working from c' to C, and would in either case miss the coal; in the latter case they might go very far astray.

Faults are generally divided into *dip-faults* and *strike-faults*, according as the direction of the fault approaches that of the dip or of the strike of the strata. The two

Fig. 3.



kinds pass into each other; the more a dip-fault deviates from the direction of dip, the more does it approach a strike-fault, and *vice versâ*. The effect of a dip-fault on the surface is to produce an apparent lateral shift of the strata, the amount of the shift being spoken of as the *heave* of the fault. There is, however, no true lateral displacement; the surface result is the combined effect of vertical shift and denudation, the latter obscuring the true nature of the shift by planing down the surface on both sides of the fault-line.

Trough-faults are faults slightly inclined to each other, and inclosing wedge-shaped masses, in which there has been sinking relative to the surrounding strata. This will readily be understood from fig. 3.

Step-faults are a series of nearly parallel faults producing a step-like arrangement of the strata which they disturb.

The ultimate cause to which faults are generally ascribed is the cooling of the earth. This cooling causes a shrinking of the globe, to which the rigid crust adapts itself less readily than the interior, consequently a crumpling and folding of the crust ensues, causing cracks and rents in various parts. As a rule faults appear to be the result, not of a sudden and violent fracture, but of a slow and long-continued strain, to which the rocks of the earth's crust gradually yield. This movement is believed to have been so slow that denudation could in many cases keep pace with it.

FAUN'A is a term employed by naturalists to express the whole of the members of the animal kingdom living in a particular district or at a particular time. Thus all the animals living in Great Britain constitute the British fauna; those inhabiting the land form the terrestrial fauna, those found in the seas constitute the marine fauna. In the fauna of a district of a country are not included those animals that have been introduced and are not indigenous. It is often applied collectively to all animals, the extinct species constituting the fossil fauna, and the living species the recent fauna of the world. The word is derived from the Fauni, who are supposed to be the patrons of wild animals. See FLORA.

FAUNS, mythological beings, nearly the Latin equivalent of the Greek SATYRS, but more bestial in their physical type. The Satyrs had sometimes pointed ears or a little tufted tail to show their kinship with wild nature; but the Fauns had horns, pointed ears, goats' feet, tails and legs, with peaked mischievous features and a character prone to low appetites. Later the Satyrs became so confused with the Fauns that they too received, very unjustly, most of these characteristics. [See FAUNUS.] Fauns have always been favourite subjects of the art of the sculptor and painter.

FAUN'US or **FATUUS**, and his consort Fauna or Fatua, were the divinities of fields and shepherd folk. The great festival of the Faunalia was held in December, when the god was appealed to for oracles. A famous Faunian oracle was situated on the Aventine Hill at Rome, but the round temple of Faunus was on the Cœlian, and there was another on the island in the Tiber. The subsidiary wild (male) protectors of the woods and fields were also called FAUNS. Just as these latter became confounded with the Greek Satyrs, so also did Faunus gradually take on all the characteristics of the Greek god PAN.

FAUST or **FUST, JOHN**, an opulent citizen of Mainz, a goldsmith by trade, whose name appears as one of the inventors of the art of printing in the manner in which that art is effected by movable types. Gutenberg and Schoeffer were the two others. Schoeffer, by inventing the puncheon, is supposed to have given completion to the discovery. It is not, however, quite certain that Faust did more than supply money to Gutenberg, who had made attempts with movable metal types at Strasburg before he removed to Mainz in 1444–45. Faust entered into partnership with him; but soon after, in consequence of a lawsuit, the partnership was dissolved, and the whole of Gutenberg's printing apparatus fell into Faust's hands, who ultimately, with the assistance of Peter Schoeffer, made the invention useful to the world. The Latin Bible in folio, commonly called the Mazarin Bible, executed between 1450 and 1455, if it was not by Gutenberg, is supposed to be the earliest production of their press.

With an exception or two, the whole of Faust and Schoeffer's productions, about sixteen in number, are in the collection at the British Museum.

Faust, whose name appears with Schoeffer's for the last time in 1466, is supposed to have died in that, or at latest in the next year, of the plague, at Paris. Schoeffer continued to print in his own name for a long time.

FAUSTI'NA was the name of two empresses of Rome, shamefully notorious for their profligacy, and the more to be abhorred seeing that they were married to the two most virtuous princes of the ancient world.

FAUSTINA THE ELDER, Annia Galeria Faustina, was the wife of the Emperor Antoninus Pius, who erected to her at her death the fine temple which still adorns the Forum at Rome. Herein she was worshipped as a goddess, *diva Faustina*. Antoninus himself was deified after his death, as was usual at that time, and his name was added to that of Faustina in the dedicatory inscription on the portico. Her admirable husband forgave or did not know of all her wickedness, and was sincerely attached to her, loading her with honours, founding hospitals and public institutions in her name, &c. She died A.D. 141.

FAUSTINA THE YOUNGER was the wife of the saint-like Marcus Aurelius, and was the daughter of the above. She eclipsed her mother as far in shamelessness as her husband outshone Antoninus in virtue. It is a standing enigma how Marcus Aurelius can have been so blind, or if not blind so weak, as to permit such a wicked creature to disgrace his virtuous nature by sharing his throne. Probably the purity of his mind was such that he could not imagine the possibility of licentiousness such as that of the empress. In his Meditations, the delight of all thoughtful men for all ages, he more than once thanks the gods who had bestowed on him so lovely a wife, so faithful, so gentle, and of so great a simplicity in manners; and his sincerity is flawless. The good emperor even advanced to state honours many of the lovers of Faustina; he alone was ignorant of what was the common talk of Rome. The Emperor Julian, in his close criticism of Marcus Aurelius, points to the deification of Faustina as the one single fault in this extraordinary man. It is often wondered at that Commodus could have been the son of Marcus Aurelius: it is but too often forgotten that he was the son of one Faustina and the grandson of another.

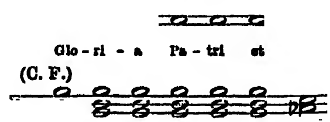
FAUS'TUS. The legend of Doctor Faustus, as we first find it in a literary form, contained the elements most likely to command popularity in the age when it had its growth. It appealed with peculiar force to the mediæval love of the marvellous, and the contemporary belief in the power of man to bring supernatural forces under his rule by superior intellectual acquirements. Its main theme was one that must always touch a sympathetic chord in the soul of man. This was the deliberate and defiant choice of evil instead of good, represented in the tangible form of the sale by a man of his soul to the devil, the price of it being present pleasure with the risk or rather certainty of future suffering. The idea of such a contract was no new one; as early as the sixth century it had taken form in the tale of "Theophilus," by Eutychianus, and had held a place in Scandinavian and German legendary lore in such tales as those of "Hroswitha" and "The Golden Legend."

At first having its origin in the notoriety of some clever magician, the legend probably formed itself, gathering together many of the tales of wonder floating in the popular mind, until it at last assumed a definite form in a work published at Frankfurt in 1587, purporting to be a life of Doctor Faustus. It was from a translation of this that Marlowe obtained the story for his tragedy of Doctor Faustus, which contains many passages of surpassing beauty. Up to this time Helen of Greece is the only heroine; it was not until Goethe wrote that Margaret was introduced.

At the beginning of the seventeenth century the legend had become a favourite piece for puppet performances. It has been surmised that it was reintroduced into Germany in this form by English travelling actors, as pedantic treatment for moral purposes is supposed to have done much to drive it from its popular position in its native country. It is said that Goethe's original draft of his great work was founded on a play as acted in a puppet show, and that Lessing, who also wrote a play on the subject, also gained his idea from the same source. In Goethe's "Faust" not only is a difference made in introducing Gretchen as the heroine of the first part (Helen, as in the older legend, being the heroine of the second part), but a change is made in the main theme, for greater prominence is given to the conscious struggle going on in every human soul between the principles of good and evil than to the deliberate choice of pleasure and sin. That there was such a person as Faustus living in the latter part of the fifteenth and the beginning of the sixteenth centuries, and that he had gained much notoriety as a magician, there seems little reason to doubt, though it is not unlikely that the name may have been a generic one for magicians before his time. He is described as having studied at the University of Cracow, and it is further narrated that, having wasted a rich inheritance, he entered into a compact with the devil to enjoy pleasure for twenty-four years, at the end of which time he was to surrender himself to the evil one. This took place, as it is said, at Rimlich, near Wittenberg, shortly after midnight, though several other places claim to have been the scene of the event.

FAUVETTE is a name of French origin very generally given to some little birds of the family Sylviidæ (Warblers), found in the country, particularly to the pettychaps, garden warbler, or Beccafico, to the blackcap, and to the reed-warbler.

FAUX BOURDON, or Falso Bordone (Italian), or Faburden, in its Old English corruption, was one of the first styles of harmony invented. Diaphony was an improvement upon the mere parallelism of the ORGANUM in Fifths or Fourths, &c., and from diaphony sprang faux bourdon. It was indeed a great step onwards to descant and to counterpoint. It provided, according to simple rules, an accompanying set of plain chords to any melody presented—a rude effect, of course, as compared with the freedom of counterpoint, but of almost unimagined sweetness to those who as yet had known no harmony. The faux bourdon was probably called *false* because it deviated from the rules of the organum, in using Thirds and Sixths and so getting full chords, which would seem at first but a modern license to those trained in the harsh chant of the organum. Mr. Helmore ("Brief Directory of Plain Song") gives many examples. The following is the opening of an example of the fifteenth century. The upper line is a soprano added for use in St. Peter's by Baini. The melody is the higher note in the lower stave, marked C. F. (canto fermo). The harmonic effect, though stiff and moving *en bloc*, is not ineffective, especially with Baini's addition.



FAV'ERSHAM, a market-town, municipal borough, and port of England, in the county of Kent, situated on a stream which runs into the East Swale, 55 miles from London by the London, Chatham, and Dover Railway. A Roman station and British town stood on its site. It was a place of some note in Saxon times, and Athelstan held a Witenagemot here in 903. King Stephen built and endowed an abbey for Cluniac monks, in which he himself, his queen Matilda, and his eldest son, Eustace of Boulogne, were buried. St. Crispin is said to have been an apprentice to a shoemaker in the town, and to have founded a monastic asylum. The town consists principally of four streets, forming an irregular cross. The church is a large

cruciform structure of flint. The town contains also various dissenting chapels, a theatre, assembly-rooms, and union workhouse. Near the town are the extensive gunpowder works of Messrs. Hall & Co. A public recreation ground of 20 acres has been laid out on the east of the town. There is a spacious literary institute, with lecture hall, &c., and a town-hall with market-place beneath it. There is also a valuable oyster fishery. The creek or arm of the Swale on which the town stands is navigable for vessels of more than 200 tons. The number of vessels registered as belonging to the port is about 280 (26,000 tons). The entries and clearances average 7500 (850,000 tons) per annum. The parish of Faversham is in the Cinque Ports liberty of Dover. The number of inhabitants in 1881 was 9484.

FAWKES, GUY or **GUIDO.** See GUNPOWDER PLOT.

FAYAL' is one of the Azores. It is situated in 38° 30′ N. lat., and near 29° W. lon., and is more than 24 miles long from E. to W. The surface, rocky, and in some parts mountainous, has nevertheless a very fertile soil, and vegetation is favoured by the mildness of the climate. The island grows firs and palms, pine-apples, oranges, &c., but the principal object of agriculture is the vine. Oranges are sent to England and corn to Brazil. Fayal is visited by many vessels for provisions or refitting. American sailors occasionally deposit large quantities of oil, the produce of the outward voyage, to be thence transhipped to American ports. The capital Horta, sometimes improperly called Fayal, is a pretty town, which in 1884 contained 9000 inhabitants; it has the best harbour in the whole group, and is the chief place of export for the produce of the Azores.

FAYETTE, LA. See LAFAYETTE.

FAYETTEVILLE, a town of the United States, in North Carolina, on the Cape Fear River, 140 miles from its mouth and 100 miles N.W. of Wilmington. Its chief manufactures are of cotton goods, and it has a considerable trade in timber, tar, and turpentine. The Cape Fear affords abundance of water-power, and is navigable up to the town. The population in 1880 was 3485.

FEALTY is the fidelity which a man who holds lands of another owes to him of whom he holds, and it consists in performing the services for which the land is granted. The law as to fealty continues unchanged, though it is not usual now to exact the oath of fealty. It is due from all tenants of land, except tenants in frankalmoigne and those who hold at will or by sufferance. The reasons for now requiring it are so few that it has nearly gone into disuse, though it serves to keep up the evidence of tenure when there are no services due.

This term had the same meaning in old Scotch law, but since the abolition of the military tenures (1747) it has ceased to have any practical significance.

FEAR is one of the most depressing of the emotions; the active energies are prostrated, and the mind seems to have no space for any idea but that which so terrifies it. The essence of fear lies in the anticipation of evil. Physical pain or mental horror, whether present or past, however acute, need not cause fear, but evils to come, whether real or imaginary, are the true source of the emotion. If a present pain is felt to be the forerunner of a future agony it causes fear, but it is the element of the future agony which is the special feature in the mental state. Anything mysterious, new, or unknown is especially likely therefore to cause fear, as objects seen dimly in the dark, or shapes of beings never before seen, since the mind forebodes all possible mischance as ready to arise from such vague portentous forms.

The result of this intensity of emotion is an almost paralysis of the body. The jaw drops, the body, especially the lips and the extremities, tremble violently; the sphincter muscles are loosed, the digestion ceases, the circulation either fails or rushes wildly on, the respiration in like manner is laboured or quickens to a mere panting, according as the fear is acute or paralyzing in its effect; the organs of excretion pour forth their products, sweat breaks out over the skin, the milk of women curdles, the hair rises in its socket, the eye glares on the object of fear, and an involuntary cry breaks forth from the parched mouth. In India the last symptom is relied on as a test of guilt. The accused is made to take a mouthful of rice, and after retaining it a moment in the mouth to thrust it out again. If the rice is moist he is let go, for it is believed that his fear will keep his mouth dry if he be guilty. This effect is doubtless due to the derangement of the great centres of nerve force; but other parts of the physical results of fear, the panting, the sweating, &c., Darwin ("Emotions") considers to be survivals from the exertions of flight natural to a frightened savage. The bristling of the hair the same authority considers akin to that of animals (as especially seen in the cat, &c.), which is unquestionably an effort to look terrible by increased size, and so to drive away the fear-causing enemy. See also EXPRESSION OF EMOTION.

Fear as a useful motive is altogether inefficacious. Its paralyzing depressing effect quite precludes all sustained effort. Slave-labour is notoriously unprofitable. Children under a severe master learn but little, and learn that little badly. Its sole beneficial use is as a deterrent from crime; fear of punishment, whether by law or by social ostracism, has saved many a weak soul from falling.

A special use of the word fear must be noticed in the fear of God. This by no means implies the dread of the unlimited power of the Almighty to ruin us in a breath, to deprive us of fortune, of family, of health, of reason, or of life. Those who fear God most love him most. In fact it is an improper use of the word, for there is nothing about the fear of God of a paralyzing nature; on the contrary it is in the highest degree stimulating to good works. It is a reverential awe at the power of God, a sense of dependence upon him, and above all a very wholesome anxiety not to offend him; just as one would do and suffer almost anything rather than cause pain to a beloved parent by one's wilful act. Fear of God must be carefully distinguished from fear of his anger.

FEAST or **FESTIVAL,** an anniversary day of civil or religious joy (from the Latin *festum*). The habit of setting aside certain times as seasons of general rejoicing would probably arise as soon as men began to form themselves into societies united on the basis of mutual interest. The natural time for such seasons would, in the first instance, be pointed out by the changes of the year, when all would be in the expectation or reception of benefits arising from the fertility of the earth. The days also on which events had happened connected with the welfare of the whole tribe, such as the birthday of a chief or the anniversary of triumphs over their enemies, would be hailed with general pleasure, and would be chosen, without any interference of the social government, by the mass of the people as seasons of rest from ordinary labour, and for the holding of friendly meetings. It is easy to imagine, from the natural tendency existing in the human soul to connect good or ill fortune with a system of rewards and punishments by some higher power, that religion would receive attention at such times. Thus as far as is known religious feasts were in use among all the nations of antiquity, with the single exception of the sun-worshipping Persians. As the founders of Christianity found it impossible altogether to alter the habits and times of keeping the feasts of the various converted nations, they were compelled as far as possible to adopt and Christianize them. This influence of paganism over Christianity is curiously shown in the festivals most observed, in the manner of keeping them, and in

the names by which they are known. Thus the use of mistletoe at Yule-tide is a remnant of the Druids' worship, and Easter is derived from the name of the Teutonic Eostre, the goddess of the dawn or of the spring.

By the twelfth century the number of Christian feasts had so increased that they seriously interfered with industry, and were the subject of constant complaint, which at length resulted in some reduction of the number by the popes. In the early days of the church Sunday seems to have been the only authorized festival, though Saturday was often kept as a holiday by those who were of Jewish origin. The custom of keeping Easter probably does not date further back than the second century, while the observance of Whitsunday, Christmas, Epiphany, and Innocents Day seems to have come into use still later. Among the Jews the Passover, Feast of Weeks, Feast of Tabernacles, Feast of Purification, and Pentecost are the principal. The Greeks, and more especially the Athenians, had an abundance of festivals; such were the Aglauria, in honour of Aglauros, the daughter of Cecrops; the Artemisia, in honour of Artemis; the Dionysia, in honour of Dionysus; the Eleusinia, in honour of Ceres; the Panathenæa, in honour of Athene; and special times set apart for the Olympian, Pythian, Nemean, and Isthmian games. The Romans celebrated both religious and civil feasts, the principal of the former being the Sementinæ, or seed-time; Lupercalia, in honour of Pan; Cerealia, Matronalia, Minervalia, &c.; and the latter, Janualia, or New Year's Day; Quirinalia, in memory of Romulus; and the Saturnalia, in remembrance of the golden age of Saturn, beginning on the 19th of December. The fixed Christian festivals are Christmas Day, the Circumcision, the Epiphany, Candlemas or the Purification, Lady Day, All Saints, and All Souls. The principal of the movable feasts, and that by which the rest are guided, and from which they keep their proper distance, is Easter; the others are Palm Sunday, Good Friday, Ash Wednesday, Sexagesima, Ascension Day, Pentecost, and Trinity Sunday. The four feasts from which leases are usually dated, and quarterly payments made, are Lady Day, 25th March; the Nativity of St. John Baptist, 24th June; Michaelmas Day, 29th September; and Christmas Day, 25th December. In the Roman Catholic and Greek churches the festivals of the various saints are still preserved.

FEATHER-GRASS (*Stipa pennata*), a grass remarkable for its elegant and feather-like awns. It grows in close, matted tufts, having very long, fine, wiry, dark-green leaves, numerous tall flower-stalks, with small florets, succeeded by an abundance of sharp-pointed elliptical grains, each of which is surmounted by the feathered awn or bristle, a foot or more in length. This is of a rich bird-of-paradise colour, and gives a remarkable beauty to the plant. Gerarde, a famous herbalist in 1597, informs us that these awned seeds were worn in his time instead of feathers by ladies. It is this species which is the principal grass in those portions of the steppes of Asia called the *trava* or pasturing grounds, growing in immense quantities, and developing its woody root-stocks above the soil, much to the annoyance of the mower. The ESPARTO-GRASS of Spain is nearly allied to the common feather-grass.

FEATHER-STAR is the name given to the species of the family Comatulidæ, belonging to the order CRINOIDEA, and subkingdom ECHINODERMATA. The feather-stars, like all Echinoderms, are exclusively marine. They are fixed by a stalk when young, resembling the sea-lilies (Pentacrinus) in appearance. The stalk is soon cast off, leaving a cup-shaped body, the exterior of which is built up of limestone plates. At the top of this calyx there are five rays, which fork one or more times, giving rise to long slender feather-like arms, fringed with smaller lateral arms, the pinnules, resembling the barbs of a feather. The long arms may be as many as 100 in number, but in the common feather-stars there are only ten. At the base of the calyx, on the top joint of the stalk, which is all that remains of it in the perfect animal, are developed little claw-like hooks, or cirri, by which the feather-star anchors itself temporarily to foreign bodies. It can detach itself at will, and swim freely through the water by means of its long feathery arms, which are the sole organs of locomotion in these animals. The mouth is usually central. The upper surface of each arm and pinnule is grooved and provided with cilia, which produce currents in the water to carry food particles to the mouth, where the grooves of the arms meet. The alimentary canal is coiled and lies within the calyx, sending no branches into the arms. It ends in the anus, which forms a tubular projection, and is situated on the same surface of the body as the mouth. The ambulacral vessels are exclusively concerned in respiration. They have no such direct communication with the exterior as in the sea-urchins, but the body-wall is pierced by numbers of small water-pores, which permit the entrance of water into the body-cavity. The blood-vascular system is well developed. The development of the feather-stars is much more direct than in some of the Echinodermata. The pseudo-embryo when hatched is a free-swimming organism, somewhat oval in shape, and provided with four transverse bands of cilia and a tuft at one end. This larval form increases in size and develops calcareous plates, and now appears as a rod-like body with an enlarged knob at the top. The rod becomes the stalk, and the knob opens and develops the arms, and thus becomes the calyx, and eventually, by the loss of the stalk, the adult feather-star.

The feather-stars are very widely distributed. The commonest genus is Comatula (or Antedon), species of which inhabit British seas.

FEATHERS are a modification of the integument peculiar to birds. Feathers are epidermic structures, and may be regarded as very elaborate, complicated HAIRS. A typical feather consists of a long central shaft forming the axis, diverging from which are a series of lateral processes, the barbs. The axis of the feather is divided into two portions. The basal portion, the quill (calamus), which is partially inserted into the skin, is a hollow, horny tube, usually transparent, and terminating in a more or less pointed or rounded extremity. The upper portion, forming the true shaft of the feather, is solid, and composed of a white spongy substance coated with a horny sheath. It tapers gradually to the extremity; its lower surface exhibits a strong groove, while its upper horny surface is usually rather convex, smooth, and continuous at the base with the tubular portion of the feather. The quill has two apertures: the lower umbilicus at its extremity, and the upper umbilicus, which opens on the under surface, at the junction of the quill and shaft.

The sides of the shaft are occupied by the webs, composed of numerous flattened plates or barbs. These are inclined towards the apex of the feather. They are usually concave in front and convex behind, so that they fit together very closely, and their mutual adhesion is provided for by the agency of a series of minute secondary hooked processes, or barbules, which spring from their margins. The shafts and webs together form the vane (*vexillum*). In many birds there is a second vane, springing from the upper umbilicus; this is the accessory plume or after-shaft. It is usually much smaller than the shaft, but in the cassowaries and emus is of equal size. It is always confined to the soft feathers forming the clothing of the body, the quill feathers of the wings and tail being destitute of it.

All feathers do not, however, conform to this type. In one order of birds, Struthiones, all devoid of the power of flight, the barbs are without barbules and unconnected with each other, giving to the plumage of these birds its soft downy or hairy appearance. The lower barbs of ordinary feathers are also generally loose and disunited, forming

the soft substance known as down. In many of the feathers clothing the body this downy portion constitutes the principal part of the feather. Many birds, especially the water-loving kinds, are clothed beneath the ordinary covering of feathers with a thick coat of down. The feathers of a bird are generally divided into those that cover the body, "contour" or "clothing" feathers, and those of the wing and tail, which are called "quill" feathers. See BIRDS.

The principal uses to which feathers are applied are for personal decoration, as plumes for ladies' head-dresses, or for the hats of military officers, and as a soft and highly-elastic material for filling beds, cushions, and pillows.

Of the various kinds of feathers employed as plumes for head-dresses the most important are those of the ostrich. They are first washed in a lather of white soap and water, and subsequently in warm clear water. They are bleached by three successive operations; first with water only, then with a little indigo, and then a little sulphur. The feathers are then dried by hanging upon cords, during which they are shaken from time to time to separate their fibres. To increase their pliancy the ribs are scraped with a bit of glass cut circularly, and to impart the requisite curly form to the filaments or fibres the edge of a blunt knife is drawn over them. Ostrich feathers are now obtained from South Africa in large quantities, and ostrich farming has become one of the chief industries of that country.

Feathers have long been used as a stuffing for beds and pillows, goose feathers especially. Goose feathers are divided into white and gray, the former being deemed the most valuable. The less valuable kind of feathers, known by the name of *poultry feathers*, are obtained from turkeys, ducks, and fowls. Wild-duck feathers are both soft and elastic, but their value is impaired by the great difficulty of removing the disagreeable odour of the animal oil which they contain. Various methods are practised of cleansing feathers from their oil, principally by the use of lime or lime-water. The larger establishments, however, now prepare bed feathers by steaming, which is found to be a cheap and efficient process. The softest and finest kind of feathers employed for bedding are those from the breast of the eider-duck, known in commerce as eider-down.

Of the quills of feathers employed for pens, those from the goose are most used. One among many modes of preparing them is the following:—A workman sits before a small stove fire, into which he thrusts the barrel of the quill for about a second. Immediately upon withdrawing it from the fire, he draws it under the edge of a large blunt-edged knife called a *hook*, by which it is forcibly compressed against a block or plate of iron heated to about 350° Fahr. By this process the barrel, which is rendered soft and elastic by the heat, is pressed flat, and stripped of its outer membrane, without danger of splitting. It springs back to its natural form, and the dressing is completed by scrubbing with a piece of rough dog-fish skin. The principal workman employed in this operation can pass 2000 quills through his hands in a day of ten hours.

The manufacture of feathers into ornaments of dress employs a vast number of industrious hands, especially females; and great skill and ingenuity are frequently exhibited in their production. The feathers most in use for military and dress purposes are those of the ostrich, the emu, the heron, the marabou stork, the ibis, the bird-of-paradise, and the osprey. The tail feathers of the domestic cock, either dyed or in their natural colours, are much used as military plumes. Swan's down is also in use for muffs and trimmings of ladies' dresses. The soft fine down of aquatic and other birds of northern latitudes, from its softness and elasticity, is of great service in contributing to the comforts of man in a variety of ways. Feathers, therefore, form a very important article of commerce. Eider-down is largely imported from Denmark, the ducks or aquatic birds that supply it being inhabitants of Norway, Greenland, Iceland, and Hudson Bay. The down of the swan is brought from Danzig. The islands west of Scotland breed numbers of aquatic fowls, which produce the eider-down, and prove a source of profitable trade for the poorer inhabitants.

A great extension of the feather trade has taken place in recent years, due chiefly to improvements in dyes and dyeing. The use of ornamental feathers in ladies' bonnets, hats, and head-dresses fluctuates, of course, with the changes of fashion.

FEB'RUARY, the second month of the year. Its name is derived from *februare*, to purify or cleanse. The Saxons called it *Sol-Monath*.

February was not in the calendar of Romulus. It was added to the year by Numa, who gave it the twelfth place in the calendar. The decemviri transferred it to the place in which it now stands. In an ordinary year February has twenty-eight days; in bissextile or leap year it has a twenty-ninth or intercalary day.

FÉCAMP, a seaport of France, in the department of Seine-Inferieure, is situated 22 miles N.N.E. from Havre, at the mouth of the river Fécamp, and on a branch railway from Rouen. It covers 2 miles of a long narrow valley, shut in by steep and barren cliffs, several hundred feet high, on one of which is a lighthouse. The harbour, which is formed by two jetties, is frequented chiefly by fishing craft, colliers, and Baltic timber vessels; a mass of water, shut in by sluices at high tide, is set free at low ebb, for the purpose of sweeping the sand and mud out of the port. The Church of Notre Dame, which belonged to the former Benedictine abbey, is a large handsome structure, in the Early Pointed style; it dates from the beginning of the thirteenth century, and has a beautifully finished interior; the choir and lady-chapel are adorned with some exquisite wood-carvings. The town has a naval bureau, tribunal of commerce, school of hydrography, several cotton-mills, sugar refineries, tan-yards, saw-mills, shipbuilding docks, and some trade in wine, brandy, oil, linen, broadcloth, hardwares, &c. It is an entrepôt for colonial produce, salt, Holland gin, and tea. Vessels are fitted out for the cod, herring, and mackerel fisheries. Population, 12,211. Fécamp is the *Fiscarium* or *Fiscanium* of the Romans.

FECUNDA'TION. See FERTILIZATION.

FEDERA'TION is a term denoting, in its simplest form, the union of a number of independent states for mutual advantage and protection, under an agreement or treaty specifying their several responsibilities and privileges. In modern times the perfect federation of theory is one in which each of the uniting powers retains complete control within the boundaries of its own state, but is at the same time ready to submit to the decisions of the federal government in all matters relating to the general welfare. The difficulty, however, of drawing a line of jurisdiction defining general and separate interests is so great that it is hardly possible that such a federation can have an active existence. It will generally happen, that either one of the states will have a preponderating influence, and will be able to enforce the policy that suits her own interests on the weaker states, or that the federal government will encroach on the internal sovereignty of the separate kingdoms. Thus the policy of the Germanic Confederation was generally guided by regard for the interests of Austria or Prussia, while in the United States of America and the republic of Switzerland the federal government assumes extensive powers of legislating in the affairs of the individual citizens of the separate states. The most ancient real federation of which we have certain knowledge is that of the Achæan League, a union which flourished from 281 to 146 B.C.; and the latest the confederation of the Dominion of Canada, the states forming which, while still acknowledging the sovereignty of England, yet exercise complete control over their own affairs.

The most important federation the world has ever seen is that of the United States of North America. The terms of its union are defined by a written instrument called a constitution. The ministers for carrying into effect the federal government are the president and Congress, and the judiciary of the United States. By the preamble to the constitution it is declared that the "people of the United States" are the contracting parties. The several states of the union are, however, often called sovereign and independent states, because they retain all the sovereignty which they have not given up, expressly or by implication, to the general government. The fifth article of the constitution provides that "the Congress, whenever two-thirds of both houses shall deem it necessary, shall propose amendments to this constitution, or, on the application of the legislatures of two-thirds of the several states, shall call a convention for proposing amendments, which, in either case, shall be valid to all intents and purposes as part of this constitution, when ratified by the legislatures of three-fourths of the several states, or by conventions in three-fourths thereof, as the one or the other mode of ratification may be proposed by the Congress; provided that no state, without its consent, shall be deprived of its equal suffrage in the Senate." It will be seen that it is assumed by this article that the several states may be bound without their unanimous consent. If so, it would appear at first sight that the civil war in America in 1861–65 could not be justified on the part of the Southern States, they having voluntarily joined the federation and agreed to the terms of the "constitution." But they alleged that the above article was contrary to conditions essentially implied by the nature of the union, and that it also involved the inconsistency that the sovereign in any state could bind his successors.

One of the chief difficulties which arise in organizing a federal government consists in discovering by what means the disagreements between one or more local governments and the central government, as to the limits of their respective powers, may be disposed of. The plan adopted in America, which so excited the admiration of M. de Tocqueville, is explained by John Stuart Mill in his "Representative Government" as follows:—"Under the more perfect mode of federation, where every citizen of each particular state owes obedience to two governments—that of his own state and that of the federation—it is evidently necessary not only that the constitutional limits of the authority of each should be precisely and clearly defined, but that the power to decide between them in any case of dispute should not reside in either of the governments, or in any functionary subject to them, but in an umpire independent of both. There must be a supreme court of justice and subordinate courts in every state of the union, before whom such questions shall be carried, and whose judgment on them, in the last stage of appeal, shall be final. This involves the remarkable consequence, actually realized in the United States, that a court of justice, the highest federal tribunal, is supreme over the various governments." It is unfortunate that the plan so lauded by the above philosophers signally broke down during the war of secession. Its efficiency, however, in all ordinary circumstances has been amply proved by experience.

FEE'JEE ISLANDS. See Fiji.

FEELING is the first of the three great departments of mind, preceding everything else, and the basis of all knowledge and mental growth. Mind consists of feeling, of will, and of thought or intellect; and of these feeling is subdivided into sensations and emotions, the first comprising feelings proper, physical states, and the second mental and frequently derived states. Yet emotions always have a strongly marked physical side; and it is matter of the commonest observation that the repression of the physical expression of emotion is the best way to keep down the rising flood of feeling. Thus a man bites his lip under vexation rather than allow himself to speak, and in a moment or two becomes sufficiently master of himself to reply with calmness. See Sensation, Emotion.

FEES. The rewards paid to barristers, physicians, attorneys, and surgeons for their several services are called fees, and may be recovered by the three last named by action; but barristers cannot recover their fees by law. Advocates in Scotland are in the same position. See Honorarium.

FEHME, FEHMGERICHTE, or **VEHMGERICHTE,** celebrated secret associations of Germany which flourished from the end of the twelfth to the middle of the sixteenth centuries. Arising in Westphalia from the relics of the old Teutonic free courts, they derived strength from their power to check and restrain the prevailing lawlessness and oppression of the times. Originally only the natives of Westphalia were admitted members of these societies, and though their limits were afterwards considerably extended, that country was ever the stronghold of the system. The members of the Fehme were required to be such as had been born in lawful wedlock, were Christians and men of good character, and were not parties to any process before one of its courts. They were initiated by certain impressive ceremonies, and were required to take the most solemn oaths to conceal the proceedings of the society, to assist in carrying out its decisions, and to support its authority by all means in their power. Two kinds of courts were held: one open to persons not members of the Fehme, which dealt with trifling offences, and the other in secret limited strictly to members, for the trial of persons accused of serious crimes. The courts were held at night in secret places, and the accused person was always summoned to appear before them. If he came a form of trial was gone through, and he was allowed to plead and produce witnesses. If he failed to appear he was tried in absence by the court. Members of the Fehme were not exempt from jurisdiction, but might be tried the same as other persons, though they possessed certain privileges not granted to outsiders.

The one penalty inflicted by these secret courts was death, and the condemned person was generally hanged. Every member of the brotherhood was pledged to carry out the decree of the court, hence it was almost impossible to escape the penalty. The power of these tribunals was as great as that of the Inquisition, and their terror extended over all Germany.

For a long time they exercised their great powers for the benefit of the community, and served as powerful restraints upon the cruelty and licentiousness of the governing classes; but they ultimately became corrupt, tyrannical, and cruel, and being zealously opposed by the various governments their influence waned and disappeared.

The Fehme courts retained but a shadow of their authority at the close of the sixteenth century, but they were not legally abolished until 1811.

There is much that is obscure and uncertain in the history of these tribunals, and which from their secret character will never be known.

FEIGNED ISSUE. In former times where a matter came before a court of law or equity for its decision upon motion, if a material fact in the case was denied, and the court thought it of too much importance to be judged of summarily upon affidavits, it might order it to be tried by a feigned issue. It was often tried by stating that a wager was laid between two parties interested in respectively maintaining the affirmative and the negative of certain propositions; but by the 8 & 9 Vict. c. 109, and by the Judicature Acts, such facilities have been given to the courts to refer issues to a jury for trial that the resort to feigned issues has become obsolete. Feigned issues seem always to have been unknown in Scotland.

FE'LIDÆ, the Cat tribe, is a family of CARNIVORA in which the organs of destruction are at the maximum of development, with the appetite for slaughter in due accordance. They are the sum and crown of the flesh-eating Mammalia, standing in the same relation to the rest of their order as the FALCONIDÆ to the other birds of prey (Accipitres). The whole structure of the Felidæ speaks in no uncertain voice of their carnivorous habits, but in no part is this perfect adaptation seen with such completeness as in the skull. Taking the skull of the tiger as our example, one cannot fail to be struck with the remarkable shortening of the facial bones as compared with the cranial portion. The zygomatic arches for the attachment of the powerful muscles of the jaw are very wide and strong. The jaws are immensely strong. The condyles of the

Skull of the Tiger.

lower jaw are transverse, and received into deeply chanuelled glenoid cavities, which almost lock them in, so that lateral motion of the lower jaw is impossible. The orbital fossæ are spacious. The auditory bullæ are large and t globul

The teeth are thirty in number. The incisors are small, six above and six below; the canines are very large, conical, compressed, somewhat curved, and sharp-pointed; the premolars are sharp and compressed. In the upper jaw there are three on each side, the first very small, the second larger, with three sharp cusps, the third is the carnassial or sectorial tooth of the upper jaw; it is very large, with three unequal sharp cusps and an inner blunt tubercle supported by a distinct root. Behind this tooth comes a very small tubercular molar. In the lower jaw there are two large premolars. The next tooth is a molar, the carnassial; it is very large and much compressed, and works against the carnassial of the other jaw. The dental formula stands thus:—

$$\text{Incisors, } \frac{3-3}{3-3}; \text{ canines, } \frac{1-1}{1-1}; \text{ premolars, } \frac{3-3}{2-2};$$
$$\text{molars, } \frac{1-1}{1-1} = 30.$$

The molars in their respective action upon each other work like the blades of a pair of shears.

Cats carry away their food to some retreat in order to devour it; hence the muscles of the neck and fore quarter are especially powerful, and enable them to lift or drag bodies of great comparative bulk and weight.

If we turn to the limbs of the Felidæ, and especially the fore limbs (take the lion or the tiger as an example), we behold a magnificent display of muscular development. They bound from ambush on their prey and dash it to the ground; they strike, and throwing out their claws as they strike, lacerate their prostrate victim. These claws or talons are retractile within a sheath, which protects them from becoming worn and blunted. All the Felidæ are digitigrade, that is to say, they walk on the tips of their toes. There are five toes on the anterior and four on the posterior extremities; these are armed with the formidable claws, which, by an admirable arrangement of the bones, ligaments, and muscles, are capable of being brought at once into sudden action, and, that action over, of rolling involuntarily back into their sheaths. This involuntary retraction, counteracted only by the action of muscles, is effected by two elastic ligaments, so contrived as to roll back the ultimate phalanx which the claw encases, and bring it down by the side of the penultimate phalanx, which is flattened on that side so as to allow it to pass unobstructed. From this retracted position within a flexible sheath the talon is brought forward by the powerful action of the flexor muscles, which counteract that of the double elastic spring, which in its manner of acting is analogous to a spiral bell-wire spring. The toes, moreover, are lifted from the ground by elastic pads of cellular tissue. There is a large basal or palm-pad, and one under each toe; these give noiselessness of tread, and conduce to ease and elasticity of progression. The limbs of the Felidæ are short, the joints well knit but supple, and every motion is free, easy, and graceful; they bound along, and leap with great velocity, most of them climbing trees with the utmost address; they swim vigorously, though generally speaking not partial to water; nevertheless, the tiger will cross rivers, and swim across creeks from island to island.

Lion's Foot dissected.

Vigour and agility characterize these terrible beasts of prey. The vertebral column is very flexible; the first two vertebræ are remarkably large and solid, the first or atlas having its lateral processes flat and expanded; the spinous processes of the dorsal vertebræ are long, with the exception of the last two or three; the transverse processes of the lumbar vertebræ are large; the spinous processes are broad, but rather short, and inclined gently forwards, but become as they advance towards those of the dorsal vertebræ more upright, while those of the dorsal, in descending, lose their obliquity. The chest is deep; the scapula is broad with a high strong spine; the clavicle is small, and merely imbedded in the muscles of the shoulder; the humerus is short and stout; it is remarkable for a high ridge or crest, which rises above the outer condyle of its lower articulation; above the inner condyle there is an orifice for the passage of the artery, which does not run round the bone, but, as it were, pierces it in a direct course onwards.

The digestive organs are simple, the intestines short, and the stomach simple and cylindrical. The brain is large and convoluted, showing a high degree of intelligence.

Sight.—This sense is acute in the Felidæ, and they have the nictitating membrane very large and movable. The eyes are placed obliquely, and glare in the dark, owing to the brilliancy of the tapetum, a membrane behind the sensitive layer of the eye acting as a reflecting mirror. The Felidæ have the eyes adapted both for diurnal and nocturnal vision. In the smaller cats the pupil is vertically linear when contracted; but in the lion, tiger, cheetah, jaguar, and leopard it is circular. It dilates with anger, and at night.

Hearing.—The sense of hearing is very perfect in the cat tribe generally; the *bulla tympani* below the auditory orifice of the skull is large and convex.

Smell.—The Felidæ enjoy this sense to a very considerable degree of perfection; the olfactory apparatus is developed to the utmost within the limited space allotted to it, yet the Felidæ are not equal in their sense of smell to the canine race.

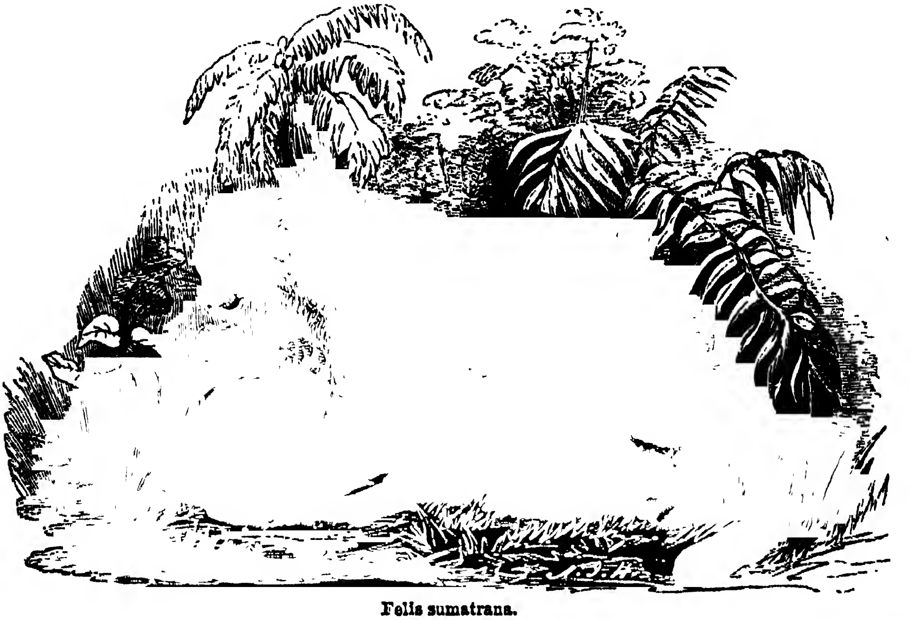
Taste.—The sense is not very refined; cats cannot be said to masticate their food; their trenchant molars merely divide the masses of flesh which they tear from their prey

into morsels of convenient size for being swallowed and submitted to the action of the gastric juice in the stomach. The roughness of a domestic cat's tongue is familiar to every one, as well as the action of lions and tigers in licking the bones of their prey, in order to detach any fragments of flesh that may be adhering thereto. This is effected by numerous horny papillæ, which are differently arranged in different species, some having them in rows, others in alternate lines; but in all the points are directed backwards.

Feeling.—In the cat tribe the long bristles, called whiskers, on each side of the mouth are in a certain sense organs of touch. They rise from a close array of glands under the skin, and each is connected with a nerve; hence they communicate to the animal an impression from the slightest touch. Their chief service appears to be to assist these animals in making their way cautiously and noiselessly through dense brushwood or jungle, or through narrow caves or other recesses, aiding the sight during the hours of darkness.

The annexed cut is of one of the smaller species of this family, and gives a general idea of their appearance as seen in their native haunts.

The osteology of the Felidæ presents little for the distinction of species, except size; and in no animals does specific character depend upon size and colour more entirely than it does in this family. There are, indeed, differences, such as that pointed out by Professor Owen, between the skull of the lion and that of the tiger; but, taken as a whole, the skeleton of a cat is very nearly the miniature representation of that of a lion or a tiger. "The principal differences," says Professor Flower, "are to be found in the form of the cranium, especially of the nasal and adjoining bones, the completeness of the bony orbit posteriorly, the development of the first upper premolar and of the inner lobe of the upper sectorial, the length of the tail, the form of the pupil, and the condition and colouration of the fur, especially the presence or absence of tufts or pencils of hair on the external ears." Upon these differences genera are sometimes founded, as Felis for the tiger and lesser cats, Leo for the lions, Lynx for the lynxes, and Cynælurus for the cheetah. The best authorities, however, prefer to bring all the numerous species under the single genus Felis. The family may be roughly divided into LIONS, TIGERS, LEOPARDS, LYNXES, and CATS, the latter including some of the smaller wild members of the tribe as well as the domestic cat. See also JAGUAR, PUMA, OUNCE, OCELOT, TIGER CAT, SERVAL, CARACAL, CHEETAH, &c.



Felis sumatrana.

Geographical Distribution of the Felidæ.—The form is widely spread over the face of the earth, but reaches its most powerful development in the warmer climates. With the exception, however, of Australia, the islands of the Southern Pacific and Madagascar, species are found in every part of the world, excepting the Arctic regions; and some extend far beyond the limits of moderate temperature, and even into districts where the severity of the cold is almost arctic. No species has yet been discovered common to the Old and New World.

FE'LIX was the name of four legitimate popes and of the most celebrated of the antipopes.

ST. FELIX was the twenty-sixth pope according to the somewhat visionary catalogue of the early bishops of Rome. He suffered martyrdom in Aurelian's persecution, A.D. 274.

FELIX II. is by some called an antipope, but ranks as a pope in the order of succession. Pope Liberius having been banished to Thrace by the Emperor Constantius, who was a vehement Arian, because he so obstinately adhered to Athanasius, Felix was appointed pope in his stead. Liberius made his peace and returned. As Felix refused to retire the emperor ordered each to be bishop over his own flock; but on the edict being read in the circus the spectators exclaimed with one voice, "What! two factions in the circus and two factions in the church! One God, one Christ, one bishop!" and rising *en masse* against Felix, they drove him across the Tiber, 358. He fought stoutly, and in his attempts to return the streets ran with blood. Eventually he relinquished the strife, and lived quietly outside Rome. He died the year before his rival Liberius, 365.

FELIX III. (483-492) is noticeable as the first pope to strike the note of discord between the churches of the East and West. Because Acacius, the bishop of

Constantinople, was attempting, with the sanction of the Emperor of the East, to heal divisions in the Eastern Church, Felix III. charged him with usurpation of authority, and even excommunicated him. The sentence was pinned upon the vesture of Acacius as he was celebrating mass, by a bold monk of the Roman obedience. Acacius calmly ordered the name of Felix to be struck off the roll of bishops in communion with the East. There is no doubt he fully expected Rome to perish utterly, and Constantinople to be on the point of becoming mistress of the world. The schism lasted nearly forty years, till the generals of Justinian reconquered the Exarchate of Ravenna and reunited Italy, or a great part of it, to the Empire of the East, when the division was brought swiftly to an end.

Felix IV. (526–530) became pope just before this last-named occurrence. He ascended a few months only before the death of Theodoric the Ostrogoth, and ruled peacefully for four years.

Felix the Antipope, called Felix V., was the pope elected by the Council of Basel after its deposition of Eugenius IV. for simony, heresy, &c.; really for stern opposition to the council itself. It was necessary to find a pope who required no revenue, and this limited the choice of the council. They fixed upon Amadeus, duke of Savoy and Piedmont, who had abdicated in 1434 and had retired to a sort of hermitage at Thonon, on the Lake of Geneva. He was elected pope by the Council of Basel after an interval of two months from the deposition of Eugenius, and took the title of Felix V. (1439). He reigned, but without any distinction, simply endorsing the acts of the council, until 1448, when Æneas Sylvius Piccolomini, by practices which will not bear scrutiny, brought about the reconciliation of Germany with the see of Rome, just before the death of Eugenius. Nicholas V., successor of Eugenius, suffered the council peacefully to dissolve, and Felix V. once more to become Amadeus of Savoy and return to his hermitage. He created him a cardinal, with special precedence next the pope himself, and annulled all the numerous sentences and censures against him. Amadeus lived three years longer, dying at Geneva, 1451. The cardinals he had made were nearly all accepted by Nicholas.

FE'LIX, ANTONIUS, the "most noble Felix" of Acts xxiv., was procurator or governor of Judea in the reigns of Claudius and Nero. He was of lowly birth, being brother of the freedman Pallas, and himself a freedman of the Emperor Claudius. He was cruel as a governor, but not unjust, and cleared the country of robbers. He was licentious in his conduct, and was living with Agrippa's wife at the time when Paul was preaching to him of "righteousness, temperance, and judgment to come." Festus succeeded him in 62, for he was recalled to Rome to answer complaints against his government, complaints so just that only the influence of Pallas saved him from punishment. When he left Judea, although Paul had been in durance for two years already without trial, "Felix, willing to show the Jews a pleasure, left Paul bound." Perhaps his neglect of his duty towards a Roman citizen is explainable by the fact that his wife Drusilla was a Jewess, and thus her friends could exercise considerable influence upon the procurator (Acts xxiv.)

FEL'LAHEEN, the people in modern Egypt that cultivate the soil. Of the various races which exist in Egypt the Fellah is the most ancient, and indeed is probably the descendant of the Old Egyptians. Although numerous invasions have introduced foreign elements into Egypt, yet the original race, devoted to agricultural labour, has always at last absorbed the invading race, and still presents a physiognomy resembling that which is found upon ancient Egyptian sculptures. They are generally of large stature, with broad chests, muscular limbs, and black piercing eyes; and are cheerful, docile, hard-working, and easily governed. Their dress is rarely more than a shirt, leaving bare the arms, legs, and breast. Their nourishment is coarse bread, water, and vegetables, to which they are sometimes able to add cheese, dates, beans, or rice. They live in huts about 4 feet high, the only furniture of which is a mat on which to sleep, a water jug, and a few kitchen utensils. They remain attached to the rudest agricultural methods, and use almost the same implements as their remote ancestors; yet the fruitfulness of the soil, which sometimes yields several crops annually, and their industry compensates for their lack of skill. They are able to endure the greatest fatigue, and to work through the whole day in a burning climate with but very little food. The women share the heaviest labours of the men. The forced labour by which, in great part, the Suez Canal was constructed was supplied by the Fellaheen, and the burden of taxation has fallen until lately almost entirely upon them. The average land tax is now at least ten times as much as in the time of Mehemet Ali, while all the necessaries of life have largely increased in price. It is not surprising, therefore, that there is a steady migration of Fellaheen into the towns, where even if still followed by the conscription, they are free from some of the heavier burdens of taxation, and earn more for their labour. They have many of the defects produced by long oppression, but they present most promising material for a great nation, if only education and good government could be insured them. See Egypt.

FELLOWSHIP, an educational preferment conferring certain privileges and advantages on the recipient, such as a right to a share of the revenue and to participate in the government of some collegiate and generally corporate body. The rights and duties are determined by the regulations of the founder of the college or the fellowship. Fellowships are either original, that is, part of the foundation of the original founder, or endowed by subsequent benefactors of a college already established. Where the number of fellows is limited by the original foundation, new fellows cannot be made members of the corporate body without a new incorporation. If the number is not limited by the charter, it seems that the corporation may admit new fellows as members, who will be subject to the statutes of the original foundation in all respects. Graduates of each several college are in general only eligible to fill a vacant fellowship in the establishment, and they are elected after having undergone an examination by the master and fellows, or by the master and senior fellows. In some cases fellowships are open to the graduates of several colleges, or even a whole university. The rules as to the election of fellows are prescribed by the founder, modified by the by-laws of the several colleges and subsequent statutes. Some fellowships may be held by laymen, but more often they can be retained only by persons already in holy orders, or who are ordained within a specified time. Fellowships are of unequal value, varying from £30 and less to £500 a year and upwards, the senior fellowships being in general the most lucrative; but all confer upon their holders the right to apartments in the college, and certain privileges as to commons or meals. Many fellowships are tenable for life, but in general they are forfeited should the holder attain to certain preferments in the church or at the bar, and sometimes in the case of his succeeding to property above a certain amount. Usually, also, they are forfeited by marriage, but this disability may now be removed by a special vote of the college.

FEL'O DE SE (Lat., a felon of himself), a person who, being of sound mind and of the age of discretion, deliberately causes his own death. When the deceased was found by the coroner and jury a felo-de-se, all his chattels, real and personal, were formerly forfeited to the crown, though they were usually restored upon payment of moderate fees. It followed from this rule that a will made by a felo-de-se was void as to his personal estate, though not as to his real estate, nor was his wife barred of her dower.

Formerly he was buried in the highway with a stake driven through his body. But by 4 Geo. IV. c. 52 it was provided that a felo-de-se should be privately interred at night in the burial-ground in which his remains might by law have been interred if the verdict of felo-de-se had not been found against him, and by the 45 & 46 Vict. c. 19, it is provided that suicides may be buried during the day-time, and, by consent of the ordinary, with a religious service.

In Scotland, where there is no coroner's inquest, the term felo-de-se is unknown, but the ancient law as regards suicides appears to have been much the same as in England. It has, however, long since gone into disuse, except as regards the claim of the crown to the personal estate of suicides, which might in theory be still enforced by action in the Court of Session. It is obsolete in practice.

FEL'ONY, in English law, in former times signified any crime which after conviction brought a forfeiture of the offender's goods. Since the passing of the Felony Act of 1870, by which forfeiture was abolished, this distinction has ceased to hold good, and the term now signifies any indictable offence which is greater than a misdemeanour. Thus crimes such as murder, burglary, robbery, arson, &c., are felonies, and private persons who witness such crimes may arrest the offender without judicial authority, and indeed are commanded by the law to do so. On the other hand frauds, libels, perjuries, and common assaults are regarded in law as misdemeanours, and with respect to these the powers of arrest both of private persons and constables are more limited. In Scotland the distinction between felony and misdemeanour has always been unknown, but that between graver and minor offences in some respects supplies its place. With this explanation the law of Scotland is much the same as that of England. See ARREST, ATTAINDER, and CRIMINAL PROCEDURE.

FEL'SPAR is the name applied to a very important group of minerals which enters largely into the composition of the earth's crust. The group is divided into several species and varieties, the more important of which will be treated separately. The points common to these species are—a specific gravity of from 2·5 to 2·8, a hardness of from 6 to 7, two well-marked cleavages, a clinohedral crystallization (that is, crystallization in either the monoclinic or triclinic systems), and a play of colours on one of the cleavage planes. The chief species are—

Anorthite, . .	Lime-felspar.	Triclinic.
Labradorite, .	Lime-soda felspar.	"
Hyalophane, .	Baryta-potash felspar.	Monoclinic.
Andesite, . .	Soda-lime felspar.	Triclinic.
Oligoclase, . .	"	"
Albite, . . .	Soda felspar.	"
Orthoclase, . .	Potash felspar.	Monoclinic.
Microcline, . .	"	Triclinic.

All the felspars are silicates of alumina with an alkali or earthy alkali, or both together. They are sometimes divided, according to their composition, into *acid* and *basic* subgroups, orthoclase ($K_2O,Al_2O_3 6SiO_2$) and albite ($Na_2O,Al_2O_3 6SiO_2$) being instances of the former, anorthite ($CaO,Al_2O_3\ 2SiO_2$) an instance of the latter division.

Another method of division, founded upon crystallographic considerations, is into *orthoclastic* and *plagioclastic*, orthoclase being the only member of the former division, all the other felspars falling under the latter head. In orthoclase (as the name implies) the cleavage planes are at right angles to each other; in the plagioclastic felspars these planes are inclined obliquely to each other, and these felspars are further characterized by repeated twining. The results of chemical analysis point to a gradual passing of one species into another, but some authorities maintain that this is due to the fact that there are in reality but three felspars (probably orthoclase, albite, and anorthite), and that all the others are simply different mixtures of two or three of these contemporaneously crystallized. Thus the felspar Perthite is formed of very thin laminæ of albite and orthoclase.

The group of minerals containing the species leucite, sodalite, Haüyn, nosean, and nephelin is closely allied to the felspars in composition and occurrence; some writers on petrology group these minerals with the felspars proper.

The felspars occur in the great majority of rocks, and Zirkel has proposed a classification of rocks founded on the presence or prevalent species of the felspars and their allies. He divides them into (1) the orthoclastic rocks, containing orthoclase (such as granite, felsite, syenite, trachyte, &c.); (2) the plagioclastic rocks, containing plagioclastic felspars (such are—diorite, gabbro, andesite); (3) the nephelin rocks; (4) the leucite rocks; and (5) a-felspathic rocks (a very small group, containing eklogite, dunite, eulysite, &c.)

The felspars and the minerals of the leucite-nephelin group give rise to clays by their decomposition; thus the kaolin of Devon and Cornwall is the result of the decomposition of the orthoclase in the granite of the china-clay districts.

FEL'SITE, FEL'STONE, and **EL'VANITE,** terms applied to a group of rocks belonging to the *acid* series. The structure of the rocks, or of the matrix in the case of porphyritic varieties, varies from amorphous to microcrystalline; looked at without a lens it exhibits a compact appearance, and frequently breaks with a conchoidal fracture. Felsites are usually porphyritic—that is, have large and distinct crystals imbedded in a matrix [see PORPHYRITIC]—the rock being known as a felspar-porphyry when the felspar crystals are noticeably large; when the quartz is especially well developed the rock becomes a quartz-porphyry. Some writers restrict the term *elvanite* to the last-named variety. Hornblende and mica (both biotite and muscovite) occur commonly in felsites; ilmenite and magnetite are occasionally found. The felsites are intermediate between the granites (which are thoroughly crystalline acid rocks) and the pitchstones and obsidians (the glassy forms); the porphyritic varieties passing insensibly into granite, the compact fine-grained kinds into pitchstones. Rocks of this group occur as dykes and veins (*e.g.* the "elvans" of Cornwall), and sometimes as interbedded sheets.

FELT, a fabric formed without weaving. Waste wool is carded, moistened with steam, and then passed through a felting machine, in which it is beaten in such a way that the fibres of the wool become interlaced one with another, forming a compact cloth. Hair and beaver felt are produced in the same way. Roofing felt is a coarse felt saturated with coal-tar or asphalt.

FEME COVERT, FEME SOLE. These are old Norman-French terms, relics of our earliest law language after the Conquest. A *feme covert* or *coverte* is a married woman, who being under *covert* of her husband could not sue or be sued for debt. A *feme sole* is a single woman; as, for instance, a *feme sole merchant*, a single woman carrying on business on her own account. The Married Women's Property Acts of 1870 and subsequent years have very greatly reduced, and in many cases obliterated, these ancient distinctions in trade between married and single women, and in that sense they are fast coming to have only a historical value. Yet even now the value of goods ordered by a wife, if they are fairly reasonable for her condition in life, cannot be recovered against her because of her coverture; the action lies against her husband. The common law gives the husband, on the other hand, large powers of restraint and control over his wife as a *feme covert*. He has the control of her person and the power to fix her residence. He, however, is bound to support her. He may give public notice that he forbids his wife to incur expenses on his account if he finds her exceeding his wishes; and in this case tradesmen can sue the wife on her personal property for goods ordered by her. The coverture

of a woman and the control it implies are held to free her from guilt if present at a crime with her husband, her presence being assumed to be due to his command. Even a felony actually committed by a woman with the knowledge of her husband (except murder or manslaughter) is held to be due to his authority under her coverture.

FENCES. When a park is inclosed to keep in deer and game the best fence is a stone or brick wall well built with lime or mortar, but as this is expensive where stone and lime are not at hand the common *park paling* is more frequently met with. This is composed of posts and rails of oak morticed and pinned together, and split pales of the same material nailed upon these in an upright position. Sometimes the pales are nailed at a distance from each other, which makes the *open-paled fence*, and the pales are then generally cut to a point at the top. Wood fences on the Continent are generally of ruder construction.

In wild mountain pastures in Scotland and Ireland it is usual to separate the properties of different individuals or that of parishes by rough stone walls put together without any mortar. The materials are generally at hand, and a rough and efficient fence is made without much labour. Where stones are not at hand a high bank of earth faced with sods of grass is substituted for a wall. Furze seed is often sown on it, and soon forms an excellent fence, which, by proper care and clipping, will last a long time. But the most common kind of fence for fields is the hedge and ditch, the bank being raised with the sods and earth taken out of the ditch, and the hedge planted in the side of the bank towards the ditch, or on the top. Where they are not required as drains, it is a great waste of land to have any ditches, and a simple hedge planted on the surface of the soil is much to be preferred. Of all fences a live hedge which is carefully planted and kept properly cut and trimmed when it is grown up, is by far the best.

When a fence is required within sight of a dwelling a deep ditch is sometimes dug, and a fence placed along the bottom of it. This is called a *sunk fence*. Sometimes a wall is built against a perpendicular side of a ditch, and some very light fence is placed obliquely outwards near the top of it, and level with the ground. This is called a *ha-ha fence*, a name given to it from the surprise excited in a person unacquainted with it, when he suddenly finds himself on the top of a wall with a deep ditch before him. A variety of *light fences of iron* have been invented for the same purpose; some of these are fixed, and others movable; some have upright pieces of cast-iron as posts let into oak blocks sunk in the ground, and rods of wrought-iron passing through holes in the uprights; some have wire for the same purpose. But the most common iron fence is composed of separate wrought-iron hurdles, which may be moved at pleasure, and are kept together by screwed pins and nuts.

It is usual in England to plant trees in the hedge-rows, and it is owing to this practice that England presents such a rich garden-like appearance wherever there is a hill which enables one to see any extent of country. It is the duty of the occupier of the land to keep the fences in repair. If two persons occupy adjoining inclosures, neither being under obligation to fence, each must take care that his cattle do not enter the land of the other. All owners of lands exposed to the inroads of the sea have a right to erect defences. A tenant is bound to preserve the boundaries of the land demised to him, and he may not stub up a quickset fence, or suffer it to be destroyed, but he may cut it in the way of trimming. Of late years iron and wire fencing have come into very general use in England and Australia. Stone fences are the least picturesque, but the most profitable.

FENCING, the art of attack and defence by the aid of a side weapon—*i.e.* by a sword, rapier, or bayonet. The rapier is the weapon which demands the highest degree of adroitness in its use; hence the word fencing is understood to allude especially to the management of this sort of sword, and when any other arm, such as a broadsword, cutlass, sabre, or bayonet is used, the kind of weapon is specified, though its use is always in accordance with the same principles.

Perhaps the first metal weapon made by man was the sword. It is mentioned in the earliest records as being a favourite weapon both for attack and defence, while in the Jehovistic narrative of the fall contained in Gen. iii., and in several other places in the Old Testament, its use is ascribed to angels also. The first swords were made of bronze, and specimens of many patterns have been found adapted both for cutting and stabbing. When steel was discovered, however, it soon took the place of other metals in the manufacture of swords, and in the productions of Damascus and Toledo we may see this metal brought to its highest perfection.

During the earlier periods of European history swords were made of great weight and strength, for the purpose of hacking through the body armour then worn, so that strength of arm, rather than skill, was requisite for their effective use. When, however, armour went out of use, a different type of weapon came into fashion, and the rapier, designed only for thrusting alternately, took the first place as a sword for gentlemen, and the art of fencing became a necessary part of their education. The part played by the sword in the practice of duelling has already been referred to [see DUEL], and where this absurd custom is retained it is still a favourite weapon for the settlement of a quarrel. Hence on the Continent the art of fencing is still studied to enable men to wield arms with advantage, but it is used to a much greater extent both there and in Great Britain as a healthful exercise and recreation. To those who are compelled to follow a sedentary occupation, there are few exercises which offer greater advantages than fencing. It serves to bring the whole of the muscles into play, expands the chest, strengthens the lungs, and gives also quickness of eye and gracefulness of demeanour. Another advantage is that it imparts to the fencer great delicacy of touch, with steadiness and lightness of hand, for which reason it is useful to artists and surgeons.

The instrument adapted for exercise is called a foil. It has a handle similar to a small sword, which it is intended to represent; likewise a guard of metal or leather between the handle and the blade, which latter is of pliant steel, circular or polygonal in shape, and having at the end a button in the place of a point. Foils vary in length of blade from about 2 feet 6 inches to 3 feet 2 inches, the latter being regarded as the maximum length permissible in the French and English schools. To guard against injury to the eyes masks of fine wire are usually worn over the face.

The fundamental principle upon which is based the defence of the person by means of the small sword, is a peculiar application of the power of the lever, whereby the fencer who parries an attack causes the point of his adversary's blade to deviate from the direct course, and throws it aside from his body by pressing or striking the feeble part (near the point) of his adversary's weapon by the strong part (near the handle) of his own. Attacks are made by means of a quick thrust proceeding from the wrist, the arm being raised and advanced by an extension movement from a parade, and by lungeing or thrusting with the arm and accompanying the movement with an advance of the right foot to give force to the blow. The upper part of the body to the right is defended by the parade (or parry) termed *tierce*, the upper part to the left by that termed *carte*, and the lower line by *seconde*. Other parades are termed *half-circle*, *prime*, and *quinte*. The fencer is expected to depend upon his sword hand for protection, rather than upon his agility of leg; nevertheless,

he must be quick and active to be able to advance, retreat, or lunge. The knees must, therefore, be somewhat bent when the fencer is on guard, that he may be light and elastic in his movements. The left arm should be moved so as to act as a balance to the body in the various movements, being bent and raised for a parade, and dropped and extended backward at about the level of the thigh while thrusting. Thrusts are directed solely at the body, and in fencing schools a hit is not counted if it alights upon a limb.

The *sword exercise* differs from fencing with the foil, in that the weapon employed has one cutting edge as well as a point, and is therefore intended to cut and thrust. The sword forms the chief weapon of the cavalry, and is the arm of all officers and many non-commissioned officers in the army, navy, and volunteers; hence sword exercise is extensively taught in both services. In practice, a stout straight stick, called a "single-stick," with a basket to protect the knuckles, is usually substituted, though "practice swords" made with rounded points and edges, and provided with cutlass hilts are sometimes used. In the sword exercise, or as it is sometimes called "broadsword" exercise, the positions are the same as in fencing, and the lunges, advances, and retreats are made in a similar manner. Seven cuts are made, directed against the left cheek, left side, and inside of the right leg, against the right cheek, right side, and outside of the right leg, and lastly at the head. Three points are also made, and for each thrust and point there are a corresponding guard and parry. In the cutlass exercise of the navy there are only three cuts and one point.

FÉNÉLON, FRANÇOIS DE SALIGNAC DE LA MOTHE, a distinguished French ecclesiastic, was born at the Château de Fénélon, in Perigord, 6th August, 1651. He came of a noble family that had already produced many distinguished men, and was carefully educated, first at home and afterwards at Cahors and the College du Plessis, at Paris. He selected the clerical profession, and in his twentieth year entered the seminary of St. Sulpice, where he received holy orders in 1675. The next ten years of his life were spent as director of an institution founded for the reception of female converts from Protestantism at Paris. While thus engaged he wrote a treatise "De l'Education des Filles," a work that has enjoyed a long period of favour, and which has been translated into English. He also composed about the same period a treatise on the pastoral office, directed against Protestantism, and a "Refutation of Malebranche's Treatise of Nature and Grace," being assisted in the latter by Bossuet. After the revocation of the Edict of Nantes in 1685, Fénélon was intrusted by Louis XIV. with a mission to Poitou to allay the excitement that had arisen, and to convert the Protestants to Catholicism. In this task he employed only the influences of argument and persuasion, refusing to undertake the work until the dragoons who had been persecuting the Protestants were withdrawn. In 1689 he was appointed tutor to the young Duke of Burgundy, and for the next six years he devoted all his powers to the fulfilment of the duties imposed upon him. For the instruction of the prince he composed a series of works, the most important of which was the celebrated "Télémaque." In 1695 he was appointed by the king to the archbishopric of Cambray, an office which he retained until the end of his life. It was about this period, however, that the controversy respecting the writings of Madame Guyon arose, in which Fénélon became involved, and the results of which embittered the remainder of his life. He had in 1687 formed the acquaintance of this remarkable woman, who was the chief exponent in France of the mystical system of religion known as Quietism, and he endeavoured to defend her against what he considered a too severe condemnation. In consequence of this he lost the royal favour, was banished from court, became involved in a quarrel with Bossuet, and finally, in 1699, came under the condemnation of the court of Rome. To the latter he submitted with the greatest humility, and published from his own pulpit the brief of his condemnation. His renunciation of the doctrines he had advocated, however, failed to procure him any return of the favour of the king, who disliked him on account of the comparative liberalism of his political principles. This dislike was increased by the publication of the "Télémaque," from a copy treacherously obtained by a secretary, in which the court saw a masked satire upon the French absolutist system of government. The book was suppressed in France, but was rapidly circulated in Holland. The king, who believed many passages of the book to be directed against himself, caused Fénélon to be restrained to the limits of his diocese, and forbade his grandson, the young Duke of Burgundy, to hold any intercourse with him. Henceforth he lived exclusively for the care of his diocese, filling up his time with works of charity and piety until he became endeared to all his people, and even more honoured in his retirement than he had been at the zenith of his fame. He died 17th January, 1715.

He was a voluminous writer, and the best edition of his works consists of thirty-eight volumes (Paris, 1827–30). See also "Life of Fénélon" (London, 1877).

FENES'TRA OVALIS and **FENESTRA ROTUNDA.** These are apertures in the bony labyrinth of the ear. The first is that which receives the foot of the little "stirrup-bone," and passes on the waves of sound from the middle ear to the inner ear or labyrinth; the second is the termination of the *scala tympani* of the cochlea, and divides it from the tympanic cavity or middle ear. Both the fenestræ are closed with a membrane. See EAR.

FE'NIAN, FENIANISM. The name Fenian, or Finian, is a corruption of that of the famous "Fianna Eirin," the ancient celebrated national militia of Ireland, "whose achievements," says Moore, "formed so often the theme of our ancient romances and songs." One of their most famous generals was Finn MacCumhal, otherwise known as Fingal, the son-in-law of King Connac (A.D. 213–253), and of the royal line of Heremon. He was hereditary general in Connac's army, and from him, according to some, the militia took their name. The ancient Fenians laid the four following injunctions upon every person admitted into the order:—1, Never to receive a portion with a wife; 2, never to offer violence to any woman; 3, never to give refusal to any mortal for anything of which they were possessed; 4, no single warrior of them must ever flee before nine champions. Some, however, think that the word Fenian is derived from Phœnician, and others again that it comes from *feeagh*, a hunt, and means an order of hunters, being synonymous with the Latin *venator*, and the German *joger*. The "Fianna" seem to have had a great love for the chase, and to have almost completely appropriated the country for this purpose to themselves.

The name has been taken in modern times by a society which originated in the United States, professedly for the purpose of destroying the union between Great Britain and Ireland, and founding in the latter an independent republic on the model of the United States of America. For this purpose a secret machinery of circles, with oaths, passwords, &c., was devised, and branches of the society were established in all parts of the United States, in Ireland, in most of the large towns of Great Britain, and in the British American colonies. The society had great hopes of a quarrel between the United States and the British governments during the American civil war, and its members have always avowed their intention to bring about a conflict between the two nations if possible. Disappointed in their hopes by the close of the civil war, the leaders of

the movement gladly availed themselves of the services of many military adventurers set free at its termination, and sent them to Ireland with a view of heading a rising. Large sums of money were subscribed in America, and strenuous efforts were made to raise recruits in Ireland. Many of the artisans and peasants of that country were induced to become members, firearms and pikes were collected, and midnight drills were conducted by the ex-American soldiers throughout the country. The British government, however, had kept a watchful eye upon these proceedings, and before the plans of the society were ripe a number of its ringleaders were seized in the office of the *Irish People* at Dublin in September, 1865. The principal capture, however, was that of the Irish head-centre James Stephens, who was arrested at Sandymount, near Dublin. Placed in the prison of that city he was enabled to escape by the connivance of a turnkey, but was compelled to flee to America, thus leaving the brotherhood in Ireland without a leader. In the spring of the following year the Habeas Corpus Act was suspended, and most of the leaders of the movement were at once arrested, but the majority of them were shortly afterwards liberated on agreeing to leave the country. Some who had been guilty of serious treasonable acts were sentenced to terms of penal servitude, and a similar punishment befell others who took part in an utterly abortive attempt at rising in March, 1867.

In England the movements of the society were of a different character. A plot was formed to seize the arms of Chester Castle, but it was frustrated by the vigilance of the authorities. A prison van was attacked in Manchester and some Fenian prisoners released, a police sergeant named Brett being murdered in the attack. A still more serious outrage was perpetrated in London, where a barrel of gunpowder was exploded against a prison wall, killing and mutilating a large number of men, women, and children in the surrounding streets. These crimes showed that some of the Fenians would stop at nothing to accomplish their ends; and although no fear was ever entertained as to the ability of the government to suppress immediately any open rebellion, the most extraordinary precautions were taken during the winter of 1867–68 in all the large towns of England. In 1868 an unsuccessful attempt to assassinate the Duke of Edinburgh at Sydney was made by a Fenian named O'Farrell, and it was not for some two or three years that a feeling of confidence returned. In 1871 nearly all the convicts were released on their agreeing to leave the country, and the movement sank into comparative oblivion for several years. Protected by American immunity, however, the society never was dissolved. Its efforts were largely assisted by the rise of the Land League in Ireland, and the ferment caused by the threats of its promoters against the British government. A new spirit of activity came over the Fenians of America, and their organs openly advocated murder and outrage as the best modes of attacking Great Britain. The continental practice of using explosives as weapons of destruction had been taught to the Fenians by many refugees from the Socialists and Nihilists of Europe, and giving up all pretence of causing a rising in Ireland they announced their intention of devoting their efforts to the destruction of life and property. That these threats were not altogether idle was unhappily proved by the savage murder of Lord Frederick Cavendish, secretary to the viceroy of Ireland, and Mr. Burke, the under secretary, in May, 1882. The perpetrators of this hideous crime were arrested in the early part of the following year, and when placed upon trial the revelations of James Carey, one of their number, threw much light upon the working and organization of these societies, and showed that many similar crimes had been designed, and had only failed of accomplishment by accident. Five of the prisoners suffered the extreme penalty of the law, and others were sentenced to various terms of penal servitude. Other movements of the brotherhood were directed towards the destruction of property in England and Scotland. In the month of March, 1883, simultaneous attempts were made to blow up the offices of the local government board and the office of the *Times* newspaper. In April four persons were arrested in London and one at Birmingham with large quantities of explosives in their possession. One of them became queen's evidence, and the others were sentenced to penal servitude for life. A considerable number of outrages were subsequently attempted in London (including one, early in 1884, to blow up four of the chief railway stations simultaneously), Liverpool, Glasgow, &c., mostly by means of explosives, but in the majority of cases the attempts failed from one cause or other, and on several occasions the conspirators were arrested and punished. It is believed that there are different factions existing in the Fenian societies, and that some of them repudiate the methods of assassination and outrage adopted by others, and further that although the "Invincible" leader Carey had professed to be a devout Roman Catholic, Fenianism has been condemned in the strongest terms by the Roman Catholic clergy, and in common with all secret societies its membership is forbidden to all members of that church.

FEN'NEC *(Canis* or *Vulpes zerda)* is a member of the Dog family closely resembling the true foxes. The body is small and slender, about 10 inches in length exclusive of the tail, which is rather over 5 inches in length. The ears are enormously developed, being nearly 3½ inches long, and standing quite erect. The tail is well developed, and dark-coloured at the root and tip, but in other respects it partakes of the general colour and character of the fur, which is of a whitish or light isabelline tint throughout, being almost white beneath the belly. Its texture is fine and woolly. The fennec is an inhabitant of the sandy plains of Nubia, where it excavates burrows. It also ascends trees with facility. The traveller Bruce was the first to describe it. The fennec kept as a pet by him was very fond of dates and other sweet fruits, and also of eggs. A fox found only in South Africa, near the Cape, resembles the fennec externally very closely. It is remarkable for having six molar teeth more than any other member of the family Canidæ, and so is usually separated under the generic name Megalotis or Otocyon.

FEN'NEL, a genus of plants, Fœniculum, belonging to the order UMBELLIFERÆ. In this country there is only one native sort of fennel, the *Fœniculum officinale*, a biennial plant with leaves cut into hair-like segments, yellow flowers, and glaucous stems, common on chalky cliffs in the southern parts of England, and generally cultivated as a pot herb for the sake of the aromatic quality of its leaves. There are several other species. Fennel is allied to DILL, but the fruits are compressed laterally, and not from back to front. It is also nearly related to Seseli, but it differs in having no calyx-teeth, and the petals are yellow and entire.

FEN'RIS or **FENRIR**, the wolf of monstrous size and power which forms so striking a conception of the Norse mythology, was, with Hel and the Snake, the offspring of Loki, the evil genius of the Norse Olympus, the god of falsehood, trick, and stratagem. Their mother was the giantess Angurboda (Anguish-giver). Odin flung Hel into the abyss of Nifelheim, where she ruled over the spirits of the dead; the Snake he flung into the ocean; but Fenris, the wolf, he caused to be chained up and fed with so much as might in some sort quiet his unappeasable hunger. But when the "twilight of the gods" drew near, and the Ases (gods) were to be punished for their shortcomings, the wolf and his progeny began to stir, and the latter roamed over the earth, while their parent shook his chains impatient for the last battle. At last it broke forth; all the enemies of the Ases attacked them at once. The wolf's children devoured the sun and moon, and in the darkness

Fenris shook off his chains and joined in the battle himself, singling out Odin as his first antagonist. His lower jaw scraped the earth and his upper jaw reached the clouds. His sister, the Snake, arose from the sea to assist him. Odin was devoured by the wolf, and many others of the Ases fell, but Fenris himself was destroyed by Widar. Then Surtur, to avenge the wolf, flung his sword of fire upon the world, and the whole universe with its inhabitants was burned up. A few of the Ases alone survived, or were born again purified by fire, as well as two beings, a youth and a maiden, hidden by All-father from the flames of Surtur and the jaws of Fenris, and destined to be the parents of the whole race of men.

FER'DINAND, a name borne by many kings of the Spanish and Austrian monarchies.

FERDINAND THE CATHOLIC was Ferdinand V. of Castile and II. of Aragon. He married in 1469 Isabella, daughter of John II. of Castile, by which marriage those two kingdoms were united. By Isabella he had three daughters: one was Catharine of Aragon, the wife of our Henry VIII. and mother of Queen Mary of England; another, Juana (Joan the Mad), married Philip, archduke of Austria, whose son, Charles V., succeeded his mother in the Spanish dominions and his father in the empire. Ferdinand took from the Moors the kingdom of Granada, their last possession in Spain, in 1492. He then drove the Jews, and shortly after the Moorish population, by the most stringent edicts, from his kingdom. It is not too much to say that Southern Spain has never recovered from this unwise act. Columbus discovered for him the New World; his general, Gonzalo of Cordova, conquered for him the kingdom of Naples; and he added Navarre to his other dominions. He was one of the most powerful monarchs of his time, and had also considerable ability; but his abilities were disgraced by a total want of faith and a recklessness of principle. He was ably assisted by his minister, Cardinal Ximenes, who emancipated the crown from the power of the feudal nobles by raising troops at the expense of the state, and by favouring the privileges of the municipal towns. Ferdinand established the Inquisition in Spain, which fearful tribunal continued from his time till 1820, when it was finally abolished. He may be considered as the restorer, if not the founder, of the Spanish monarchy. Ferdinand died in January, 1516, sixty-three years of age.

FERDINAND VI. of Spain, "the Wise," one of the Bourbon Spanish kings, reigned from 1746 to 1759, when his brother Charles IV. of Naples succeeded him as Charles III. of Spain. Charles gave over the crown of Naples to his young son Ferdinand. See below (Ferdinand IV. of Naples).

FERDINAND VII. of Spain was the unfortunate puppet of Napoleon. Ferdinand was the eldest son of the weak Charles IV. of Spain, and was born in 1784. Napoleon intended to seat his brother Joseph on the throne of Spain. At this time Spain was a mere dependant of France, and the whole Spanish royal family were induced to repair to Bayonne and place themselves in the hands of Napoleon. In 1808, by a series of audacious trickeries, both father and son were made to resign their claims to the crown in his favour. Ferdinand resided at Valençay under a strict surveillance. In 1813 the reverses of the French both in Spain and Germany induced Napoleon to restore Ferdinand to the throne of Spain, on condition that he should send the English out of the peninsula; but the cortes of Madrid refused to ratify the treaty, and wrote to Ferdinand that they would receive him in his capital as their lawful king provided he would sign the constitution which had been proclaimed at Cadiz in 1812 by the representatives of the nation. Ferdinand, however, annulled the constitution, and amid plots and strifes, proscriptions and civil wars, maintained his position till January, 1820. The constitutionalists obtained then an ascendency. Ferdinand accepted and swore on the 9th of March to uphold the constitution of 1812. For three years it was nominally adhered to by the discontented royalists on the one side, and the not always prudent constitutionalists on the other. But in the beginning of 1824, at the instigation or at least with the consent of Ferdinand, Louis XVIII. of France sent an army of 100,000 men into Spain under the command of the Duc d'Angoulême, to deliver Ferdinand. The English ministry protested against this interference, but it was carried into effect. In 1824 Ferdinand married as his fourth wife the notorious Maria Christina. One of their daughters was the subject of the shameful "Spanish marriage" that cost Louis Philippe his throne, she marrying the Duc de Montpensier, son of that king. The other daughter succeeded to the throne of Spain as Isabella II. in 1833 under every good hope, but only to become infamous for her private misconduct, and lose her crown in 1868.

Of the Neapolitan Ferdinands, FERDINAND I. (1423–94) was the natural son of Alfonso V. of Aragon, Naples, and Sicily, and succeeded to the crown of Naples—that of Sicily being separated in 1458: he was followed by FERDINAND II. of Naples, his grandson, who died in 1496. FERDINAND III. of Naples was V. of Spain also, and the crown of Naples was by him, in 1503, united to that of Spain, and remained so for over two centuries.

FERDINAND IV. of Naples ascended the throne as a boy of eight in 1759. He was the son of Charles IV. of Naples, and when his father was called to the throne of Spain (as Charles III. of Spain) Ferdinand received from him the kingdom of Naples and Sicily under a regency. In April, 1768, Ferdinand married Maria Carolina, a daughter of the famous Empress Maria Theresa, a clever and ambitious princess, who in fact ruled under her husband's name till her death, the king himself being generally passive, and his time being much engrossed by hunting, shooting, and other diversions. The first thirty years of his reign were for Naples years of peace.

On the breaking out of the French Revolution the queen, being the sister of Marie Antoinette, took a decided part against revolted France, and the court of Naples joined the first coalition, in 1792. The Neapolitan army, in November, 1798, marched upon Rome, which it occupied for a few days. The French then attacked and routed several divisions of the Neapolitans; and the rest of the army, with Mack their general and the king himself, fled to Naples, whither the French followed them closely. In the spring of 1799 the reverses of the French in Lombardy obliged them to abandon it, leaving only a small garrison there. In 1805 the court of Naples entered secretly into the coalition against France. The consequence was that Napoleon, after his victory at Austerlitz, sent a force under Massena to occupy that kingdom. Ferdinand and his court withdrew to Sicily a second time, where they remained till the fall of Napoleon in 1815. By a decree of December, 1816, the restored king assumed the title of Ferdinand I. of the United Kingdom of the Two Sicilies, declaring that Sicily and Naples formed no longer distinct states, but were both subject to the same system of government.

In 1820 a revolt, commenced by a regiment of cavalry, but excited and supported by the CARBONARI, broke out, a new constitution was proclaimed, and a Parliament was convoked at Naples. Soon afterwards the Austrian army moved on Naples, and after a slight resistance entered the city at the end of March, 1821. Ferdinand soon afterwards returned to his capital on what may be styled his third restoration. The government again became absolute, but not so lenient or liberal as it was before 1820. Ferdinand died suddenly on 4th January, 1825.

FERDINAND II. of the Two Sicilies was the grandson of the last-named king. He was born in 1810 and

succeeded in 1830. At first his rule in those troublous times was just and clement, but less wise counsels soon prevailed, and the government degenerated into a tyranny. Naples became at once a hotbed of treason and intrigue, and swarmed with republican secret societies, which the king vainly attempted to stifle by political prosecutions of the greatest rigour. In 1848 matters were at such a crisis that Ferdinand pretended to yield to the general demand of a constitution. Finding him faithless Sicily broke out into civil war, which was waged so ruthlessly by the king that he earned the name of *King Bomba* (King Bombshell). The state prisons were under this tyrant so abominable that Mr. Gladstone, becoming acquainted with their horrors, held them up to the execration of the world in a series of famous letters. King Bomba died in 1859, and was succeeded by Francis II., with whom in 1860 the detested monarchy of Naples ceased, and Garibaldi, the king having fled before him, peacefully handed over the entire state to Victor Emmanuel, then king of Sardinia. Naples thus came to form part of the quickly constituted kingdom of Italy.

The following are the Ferdinands, emperors of Germany, of the house of Austria. FERDINAND I., Emperor of Germany (1555–64), was born in Spain in 1503. He was the younger brother of Charles V., king of Spain and emperor of Germany, and succeeded him on the imperial throne in 1556. His grandson, FERDINAND II., came to the empire in 1619. While quite young he had sworn before the virgin's altar at Loretto, that Catholicism should be the religion of all his subjects at whatever cost. But the states of Bohemia, who were already in open revolt against the late emperor, elected as their king Frederick, count palatine, son-in-law of James I. of England; and Hungary joined in the revolt, supported by Bethlehem Gabor, prince of Transylvania. This was the beginning of the THIRTY YEARS' WAR, a war both religious and political, and one of the most desolating in the history of modern Europe. FERDINAND III., Emperor of Germany, was the son of Ferdinand II., and had seen so much misery in the war, following the armies of Wallenstein, that his constant aim was the restoration of peace. He ascended the imperial throne in 1637, but peace was not arranged till 1648. In fact, though the Congress of Münster met in that year, the peace of Westphalia was not actually signed till 1648. Ferdinand died in 1657.

FERIÆ, certain holidays among the Romans, which were first established by Servius Tullius, and eventually transmitted, under different forms, to the various nations of Europe. At these festivals no work was permitted to be done. The laws were promulgated; decrees made known; public declamations delivered; tents, booths, and shows erected; and various amusements practised. They were of various kinds, as the *feriæ stativæ*, which were kept by the whole city on certain days named in the calendar; *feriæ conceptivæ*, fixed by the priests or magistrates; and *feriæ imperativæ*, which were simply ordered by the consuls or other chief officers of state, for the purpose of commemorating some important event. In the middle ages these feriæ or fairs continued to be observed, but under different modifications and for rather different objects. They usually originated from the religious observances that took place at the dedication of any new church; when, on the subsequent anniversaries of this event, the neighbouring farmers and tradesmen were in the habit of assembling for the purpose of disposing of their commodities or wares, and after transacting the necessary business, of indulging in rustic revelry, dancing, or other amusement.

FERM OF THE COUNTIES, with our earlier kings, was a considerable branch of the revenue. The king's dues from the counties, for judicial fees, rent of crown lands, fines, &c., were *farmed* to the sheriff, who of course extorted as much as he could from the king's debtors, and retained whatever he gained above his farm fee.

FERMAN'AGH, a county of Ireland, in the province of Ulster, is bounded N. and N.E. by Tyrone, N.W. by Donegal, S.W. by Leitrim, S. by Cavan, and E. by Monaghan. Its greatest length, N.W. and S.E., is 45 miles; and its greatest breadth, N.E. and S.W., 29. The area is 714 square miles, or 457,869 acres. The population in 1881 was 79,167, showing a decrease of over 13,000 as compared with 1871, and of over 70,000 since 1841. The county is traversed by the Irish North-western, the Derry and Enniskillen, and the Enniskillen, Bandoran, and Sligo railways.

Fermanagh is divided into two nearly equal portions by Lough Erne, which lies almost entirely in the county of Fermanagh, and traverses it from one end to the other. [See ERNE, LOUGH.] The limits extend from Beleek on the north-west to Wattle-bridge on the south-east, a length of 45 miles. Several large rivers empty themselves into the lake, which are navigable for boats for 2 or 3 miles up. A steamer plies daily between Enniskillen and Belleek. The portion of the county which lies south of Lough Erne contains a large tract of waste and mountain land, which is bounded on the south by Lough Melvin and Upper and Lower Lough Macnean. It contains seven or eight elevations more than 1000 feet in height; and among them are many small lakes and limestone caverns, through which the smaller rivers flow. The district north of the Upper Lough Erne is less mountainous, more fertile, more thickly inhabited, and contains a greater number of fine residences.

The rivers of Fermanagh are small. From the mountainous district on the south-west the Silees and Arney run into Lough Erne: the Cloddagh or Swanlinbar River, flowing south-east of Cuilcagh, has a like termination. The Woodford and the Drumany or Colebrook both fall into Lough Erne.

The climate is somewhat cold and moist; violent winds are common in winter, and render the navigation of the lake dangerous. The largest part of the county under cultivation is occupied by meadow and clover; potatoes and turnips are the principal green crops, and oats the chief cereal. A considerable quantity of flax is also raised. Much attention is now given to the breeding and feeding of cattle and sheep, of both of which large numbers are exported, and of a very good quality. The soil is mostly cold and moory, but has been brought into a good state of productiveness throughout the arable districts. Fermanagh is more wooded than most Irish counties. The linen manufacture is carried on, but only to a small extent. There are some extensive quarries of sandstone and limestone.

The county is divided into eight baronies and twenty-three parishes. It returns two members to the House of Commons; the number of voters is about 4500. The chief town is ENNISKILLEN.

Fermanagh was first erected into a county by statute of the 11th of Elizabeth, but it was not till the time of the plantation of Ulster that it was finally brought under civil government. Having fallen to the crown upon the flight of the Earls of Tyrone and Tyrconnell, it was divided among Scottish and English undertakers and native Irish. The subsequent forfeitures of 1641 affected a large portion of Fermanagh, and considerably increased the possessions of those from whom many of the present proprietors are descended.

FERMENTATION, a term applied to the change which many animal and vegetable substances undergo after exposure to the air, and in the presence of certain nitrogenous bodies called ferments. The result of the change is generally to split up the complex organic structures or compounds into products of a simpler composition. The term is applied also to putrefaction, or the slow decay of

organic substances exposed to the action of air and water; this is accompanied usually with an offensive odour. [See EREMACAUSIS.] There are several well-marked forms of fermentation proper, which differ widely both in the compounds in which the process occurs and in the products obtained. In almost all cases, however, these products are simpler in character; in some they are of great commercial importance. In many cases water, carbonic acid gas, or ammonia is evolved; in others there is no evolution of gas at all.

Few processes have given rise to more controversy among chemists than those of fermentation. It has been long known that exposure to the atmosphere is necessary to start the process, but that it continues in closed vessels from which the air is excluded. The action of the nitrogenous ferment was at one time held by Berzelius and Liebig to be catalytic, a term expressing the idea of presence, or simple contact—the ferment being in a state of unstable equilibrium, it was supposed, to induce a re-arrangement or splitting up of the elements in other bodies which are perfectly stable alone. There is no longer any doubt, however, that these nitrogenous ferments are always accompanied by the germs of certain minute fungi derived from the air, and that the fermentation cannot occur without their presence. Exclusion of air prevents all fermentation; this was held to be due to the necessity of oxygen, but the balance of evidence is strongly in favour of the theory that it is due to the germs so introduced. What is the precise action of these minute organisms is not absolutely known; it may be that the fermenting substance forms their food, but the investigations of Pasteur have established the fact that to their vital force the fermentation is mainly due. The best known kinds of fermentation, and the most important, are the vinous and the acetous. Vinous fermentation is the conversion of sugar into ALCOHOL; acetous fermentation is the further change of the alcohol into ACETIC ACID. [See VINEGAR]. When a juice of any fruit containing sugar is exposed to the air in a warm place, a change is soon noticed; it deposits a nitrogenous matter, which is the ferment, and the whole liquid is soon in a state of effervescence: the ferment is acting on the sugar and splitting it up into alcohol and carbonic acid, which escapes as gas. If the liquid be now examined with the microscope a small microscopic fungi, consisting of minute round cells about $\frac{1}{1000}$ of an inch in diameter, will be observed. This is known as *Torvula cerevisiæ*, and always accompanies vinous fermentation. If, after this change is complete, the juice be further exposed to the air it absorbs oxygen, and the acetous fermentation commences, and continues until all the alcohol is converted into acetic acid. This was held by Liebig to be due to simple oxidation, but on examination by the microscope another minute fungus will be found by which this new change is effected. This is called the *Torvula aceti*. Although alcohol and acetic acid are the principal products thus obtained from sugar, the process is not quite so simple, as a number of other substances are also formed in minute quantities. Yeast, which is the most common ferment used in making beer and spirits from malt, attracts and contains the germs of *Torvula cerevisiæ* and of *Penicillium glaucum;* this latter fungus is concerned in the lactous fermentation, or the conversion of sugar into lactic acid, an acid generally present in beer, but more largely in butter-milk. [See LACTIC ACID.] The use of yeast for raising bread depends upon the fermentation of the starch and sugar of the flour into alcohol and carbonic acid, both of which are expelled in the baking. Other fermentations are the amygdalous fermentation, or the formation of bitter almond-oil from amygdalin, in which the emulsin of the almond is the ferment; the gallous fermentation, or formation of gallic acid from the tannin of galls: in this the pectase of the gall-nut is the ferment; the mucous fermentation, converting sugar into gum and mannite, the result of a peculiar fungus acting on albumen; the urinous fermentation, or the conversion of urea into carbonate of ammonia, the mucus of the bladder acting as the ferment: yeast will also effect this change. The conversion of starch into sugar by the action of the ptyalin of the saliva in mastication, and by diastase in malting, and the formation of oil of mustard by myroxin, may also be mentioned among many other instances of fermentation. Antiseptics which destroy the organisms arrest fermentation. Exclusion of air, high and low temperatures, and perfect dryness, all prevent fermentation and putrefaction, and are therefore generally conducive to the preservation of animal and vegetable substances. Smoked provisions, tinned meats, dried fruits, and frozen carcases are all important and extensive applications of these principles. The success in all is dependent on the prevention or destruction of fermentive germs. Pasteur's studies of fermentation have led also to important results in the germ theory of diseases. See BACTERIA.

FERMENTED LIQUORS are alcoholic beverages made by fermentation of saccharine fluids and juices, chiefly ale, beer, stout, and porter, made by fermentation of an infusion of malt; and wine, by fermentation of the juice of grapes. Lighter wines are also made from the juice of other fruits, as currants, gooseberries, and other home fruits; and sometimes from the juice of roots, as parsnips, &c. Cider is made by fermentation of the juice of apples, perry from that of pears. The sap of many trees is used abroad for fermented liquors, as the American aloe, the birch, the palm, the maple, the cocoa-nut, &c.

FERMOY', a market-town of Ireland, in Munster, in the county and 19 miles N.N.E. of Cork, situated on both sides of the Blackwater, but the larger part is on the south bank, where the principal business is carried on. On the north bank are extensive infantry barracks, which formed two large quadrangles, but the western quadrangle has been converted into a union workhouse. The town is regularly laid out, and contains several good streets, a court-house, church, Roman Catholic and other chapels, and numerous schools. Fermoy College, two convents, and St. Colman's Roman Catholic College are situated on the high grounds rising over the town. Fermoy has grown to its present position within the last seventy or eighty years. It was made a military station in 1797. There are flour-mills and a large trade in agricultural produce. The population in 1881 was 6454.

FERNAN'DEZ, JUAN, is the name of a small group of islands in the Pacific, about 400 miles from the western coast of South America. The group consists of two larger islands, Masatierra and Masafuera, and a few small rocks. Masatierra, which alone is often called Juan Fernandez, is situated in 33° 40′ S. lat. and about 100° W. lon. Masafuera, which is more than 2° further west, in the same latitude, is a heap of immense rocks rising precipitously from the sea to the height of 3000 feet and more, without any convenient landing-place. Masatierra, the larger of the two, is about 18 miles long, but only 6 miles across in its widest part. Towards the northern extremity is Cumberland Bay, which affords safe anchorage for vessels of any size. Goats in a wild state are found here. The buccaneers of the seventeenth century, finding these islands uninhabited, made them a place of resort during their cruises on the coasts of South America. On one occasion, a Scotchman, named Alexander Selkirk, being left on the island of Masatierra, lived there more than four years, and the knowledge of this fact suggested to Defoe the story of "Robinson Crusoe."

FERNAN'DO PO, an island situated on the western coast of Africa, opposite the mouths of the Niger, in the Bight of Benin, 3° 25′ N. lat., and 8° 50′ E. lon., is about 44 miles long and 16 broad. Its surface, which is very uneven, rises towards the centre into two summits, one of

which attains a height of 10,700 feet above the sea. It is covered with wood, and is everywhere well watered and fertile. Yams, palms, and other tropical plants grow abundantly, and turtles and fish are plentiful. There are several small harbours; the largest is Maidstone Bay, on the northern shore, which is formed by a headland called Point William, rising 150 feet above the sea, on which the English settlement of Clarence Town was established in 1827. This island was discovered in 1741 by the Portuguese, who in 1788 ceded it to Spain. In 1827 the English took possession of it until 1844, when it again reverted to Spain.

FERNEY or **FERNEX**, a town of France, in the department of Ain, 4 miles north-west of Geneva, in a beautiful situation at the foot of the Jura. It owes its prosperity to Voltaire, who purchased the estate in 1758, and began a series of improvements. Out of a few miserable huts he constructed a neat little town. He established a colony of artisans, chiefly watchmakers from Geneva, rebuilt the church and drained and planted the neighbouring grounds. He resided here for nearly twenty years.

FERNS (Filices) form a group of flowerless plants or CRYPTOGAMIA. The Thallophytes, Characeæ, and Muscineæ among Cryptogamia have a simple cellular structure, but vessels occur in the stem of ferns, and therefore these, together with Equisetaceæ, &c., are grouped together as Vascular Cryptogams. From Ophioglossaceæ (which have been usually classed with ferns) and other vascular cryptogams they are briefly distinguished by the prothallium being above ground and green, and the sporangia being epidermal structures of the leaves.

Pliny states truly that ferns "bear neither seed nor flower," for what is popularly known as fern seed differs from true seeds of flowering plants in having no embryo. It is better therefore to substitute the word *spore* for seed, as the difference between them is of the first importance. But it was not possible to appreciate this fact without the aid of the microscope, and the spores are so exceedingly minute that the general opinion of the ancients that there was nothing corresponding to seed may well be excused. A later notion was that ferns only shed their seed on one night in the year—the eve of St. John the Baptist. Butler in his "Hudibras" calls the bracken fern—

"The wondrous one-night seeding fern."

The minuteness of the spores was seized upon by mediæval botanists and utilized in their doctrine of "signatures," a doctrine which is illustrated by many of our common names of plants; *e.g.* "eyebright" (Euphrasia) has marks on its petals which look somewhat like the eye, and this was considered a mark designed by the Creator to show man that this plant possessed the virtue of being healing to the eyes. In the same way it was inferred that the use of fern seed would insure concealment. Shakspeare alludes to this belief in "Henry IV."—

"We have the receipt for fern seed, we walk invisible."

When the spores of ferns are sown on damp soil they germinate after some time, by the "skin" of the spore (*exospore*) bursting and the cells of the interior dividing and growing out into a green expansion, called the *prothallium*. The prothallia produce numerous root-hairs and structures known as archegonia and antheridia, corresponding to the ovaries and anthers of flowering plants. From the fertilized archegonia spring up new plants, with stems, roots, and leaves.

Ferns have a wide geographical distribution, the herbaceous and shrubby kind being found towards the north and south poles, while the tree-ferns rival the gigantic palms in the forests of tropical climates. Wallace, in his "Tropical Nature," speaks of ferns as follows:—"The type of plants which, next to palms, most attracts attention in the equatorial zone is perhaps that of the ferns, which here display themselves in vast profusion and variety. They grow abundantly on rocks and on decaying trees; they clothe the sides of ravines and the margins of streams; they climb up the trees and over bushes, they form tufts and hanging festoons among the highest branches. Some are as small as mosses, others have huge fronds 8 or 10 feet long, while in mountainous districts the most elegant of the group, the tree-ferns, bear their graceful crowns on slender stems 20 to 30 or even 50 feet high. It is this immense variety rather than any special features that characterizes the fern vegetation of the tropics. We have here almost every conceivable modification of size, form of fronds, posture of spores, and habit of growth in plants that still remain unmistakably ferns. Many climb over shrubs and bushes in a most elegant manner, others cling closely to the bark of trees like ivy. The Great Bird's-nest Fern (Platycerium) attaches its shell-like fronds high up on the trunks of lofty trees. Many small terrestrial species have digitate, or ovate, or ivy-shaped, or even whorled fronds, resembling at first sight those of some herbaceous flowering plants. Their numbers may be judged from the fact that in the vicinity of Tarrapoto, in Peru, Dr. Spruce gathered 250 species of ferns, while the single volcanic mountain of Pangerango, in Java (10,000 feet high), is said to have produced 300 species."

The properties and uses of the ferns are not in proportion to their numbers in the vegetable kingdom. Many of them deposit starch in their rhizomes, from which food may be prepared. The roots of *Nephrolepis tuberosa* are eaten in Nepal; those of *Angiopteris evecta* are used in the same manner in the Sandwich Islands. *Diplazium esculentum*, *Cyathea medullaris*, *Pteris esculenta*, and *Gleichenia dichotoma* all yield starch, and are employed as food in different countries. [See CYATHEA.] The Maidenhair Fern (*Adiantum Capillus-Veneris*) yields astringent and aromatic secretions. [See ADIANTUM.] Some of the American polypodiums are said to possess powerful medicinal effects, and are used as antirheumatic, antivenereal, and febrifugal remedies. The *Angiopteris evecta* yields an aromatic oil, which is used in the Sandwich Islands to perfume the fixed oils, as cocoa-nut oil. The stems of many species contain bitter principles, and have hence been used as tonics. Species of Aspidium and Asplenium have been used in European medicine. [See ASPLENIUM.] The Brazilian natives form tubes for their pipes from the stems of *Gleichenia dichotoma*. The Flowering Fern (*Osmunda regalis*) had once a great reputation in medicine.

Ferns are classified to a very great degree by the fructification which is produced upon the leaves. The spores are contained in spore-cases (*sporangia*). A group (*sorus*) of spore-cases is figured in Plate FERNS, fig. 1, *a* and *b*. Most spore-cases have a ring (*annulus*) of thickened cells, and when the spores are ripe this ring dries up, and by its contraction causes the spore-case to split and shed the spores. The position of the ring—vertical, oblique, &c.—is of use in classifying ferns; other marks are found in the form and position of the sori, the presence or absence of a membranous cover (*indusium*—see Plate, fig. 2) on the sorus, and the form and mode of attachment of the indusium.

The classification of ferns is to a great extent artificial, and must remain so until more progress has been made in our knowledge of the development of the prothallia in the various groups. The general arrangement at present is as follows:—

I. *Polypodiaceæ.* Sporanges stalked with a vertical, usually incomplete annulus, splitting transversely; receptacle not prominent. Genera, 50; species, 2000. Mettenius distinguishes five subdivisions of this group.

(*a*) *Acrosticheæ.* The sori cover the surface and veins of the under side or both sides, or are placed upon a

thickened receptacle which stands on the vein. There is no indusium. Examples:—Acrostichum, Polybotrya.

(*b*) *Polypodieæ*. The sori occupy either the whole length of the veins, or special anastomosing branches of it, or the back or thickened end of a vein. They are naked, or with a lateral indusium. Examples:—Pteris (brake), Adiantum (maiden-hair fern), Polypodium (see Plate, fig. 3, *Polypodium vulgare*).

(*c*) *Asplenieæ*. The sori are unilateral on the course of the veins, and are covered by a lateral indusium, or rarely without any; or they extend at their apex over the back of the veins, and are covered by an indusium springing from it; or they occupy special anastomosing branches of the veins, and are unilateral and covered by an indusium free on the side of the vein. The leaf-stalk is not articulated. Examples:—Blechnum (hard fern), Asplenium (see Plate, figs. 4 and 4a, *Asplenium viride*, green spleenwort), Scolopendrium (hart's-tongue).

(*d*) *Aspidieæ*. The sori are dorsal on the veins, covered with an indusium, or terminal and without indusium. Examples:—Aspidium, Phegopteris.

(*e*) *Davallieæ*. The sori are terminal on a vein or at a fork, and are furnished with an indusium; or are placed on an intramarginal anastomosing bend of the veins, and covered with a cup-shaped indusium, free at the outer margin. Examples:—Davallia, Nephrolepis, Cystopteris (see Plate, fig. 5, *Cystopteris montana*, bladder fern).

II. Osmundaceæ. Sporangia shortly stalked, with a horizontal bar instead of an annulus, splitting longitudinally. Genera, 2; species, 12. Example:—*Osmunda regalis* (flowering fern).

III. Cyatheaceæ. Sporangia not stalked, more or less elevated on a common receptacle, with a complete oblique annulus, and splitting transversely. Genera, 3; species, 150. Examples:—Cyathea, Alsophila, which include species with columnar stem (tree-ferns).

IV. Gleicheniaceæ. Sporangia not stalked, with a complete transverse annulus, and splitting longitudinally. Sori are dorsal, without indusium, and mostly formed of a few, sometimes of only three or four, sporangia. Genera, 2; species, 30. Examples:—Gleichenia, Mertensia.

V. Schizæaceæ. Sporangia without or with a very short stalk; the annulus in the form of a cap at the summit; splitting longitudinally. Genera, 5; species, 60. Examples:—Schizæa, Lygodium (climbing fern).

VI. Hymenophyllaceæ. The Sporangia are not stalked, with horizontal annulus, and splitting longitudinally; sori composed of numerous sporangia arranged on a long filiform receptacle. Genera, 2; species, 150 to 200. Examples:—Hymenophyllum (see Plate, figs. 6, 6*a*, 6*b*, *Hymenophyllum tunbridgense*, Tunbridge Wells fern), Trichomanes.

(Consult "Synopsis Filicum," by Sir W. J. Hooker and J. G. Baker; "Historia Filicum," by J. Smith; "Handbook of British Ferns," by T. Moore; "The Fern Garden," by Shirley Hibberd.)

FERO'NIA, the name of a genus of plants belonging to the order Rutaceæ and tribe Aurantiaceæ. *Feronia elephantum* is the elephant or wood apple of the Coromandel coast, where it is very generally eaten. The branches of this tree are armed with small spines. The fruit is fleshy, and extremely acid before it arrives at maturity; but when ripe it contains a dark brown agreeable subacid pulp. In appearance the fruit is large, spheroidal, rugged, and often warted externally; the seeds are in five parcels, and are flat and woolly, adhering to the branched placentæ by means of long cords. A transparent oily fluid, which is used by painters for mixing their colours, exudes from the trunk of this tree when an incision is made into it. A clear white gum may also be obtained from the tree very much resembling gum-arabic; in fact it forms part of the East Indian gum-arabic of commerce. The wood is likewise valuable on account of its durability, whiteness, and hardness. The genus Feronia comes very close to Citrus, but there are only from ten to twelve stamens, the ovary is imperfectly five or six celled, and the leaves are pinnate. It is found not only in India, but in Ceylon and Java.

FEROZESHAH. See Firozshah.

FEROZPORE. See Firozpur.

FERRA'RA, a town of Italy, the capital of the province of the same name, and an archbishop's see, is situated in the midst of a flat country on the north bank of an arm of the Po, 26 miles N.N.E. of Bologna. It is a large and well-built town, with streets wide and straight, the principal of which, called San Benedetto, is about 2000 yards in length. It is inclosed by walls, and in the centre is a castle, flanked with towers and surrounded by wet ditches. The town contains numerous churches, most of them rich in paintings by masters of the Bolognese and Ferrara schools. The finest churches are—the cathedral, built in the twelfth century; San Benedetto, San Domenico, Santa Maria del Vado, the oldest church of Ferrara, and San Francesco. Among the palaces of Ferrara the finest are those of Villa and Bevilacqua. The theatre is one of the largest and finest in Italy. The house of Ariosto, which he purchased himself, is shown to strangers. The University of Ferrara has a valuable library of 100,000 printed volumes and 1000 MSS. Ferrara is one of the most interesting and handsome of the modern towns of Italy. It contained 75,553 inhabitants in 1882, of whom more than 2000 were Jews. It has much trade in agricultural produce. In 1849 the Austrians took possession of the town, but were compelled to abandon it at the commencement of the Italian campaign in 1859. It was formally annexed to the kingdom of Italy under Victor Emmanuel in April, 1860.

Ferrara was walled by the Exarch of Ravenna in 585, and was made the seat of a bishop in 657. It passed under the Este family in the thirteenth century, and became the seat of one of the most famous courts of Europe. It was then intimately at least, if not honourably, associated with the history of some of the greatest names in the literature of Italy, or indeed of Europe. Ariosto, though born at Reggio, in Modena, resided for a lengthened period in Ferrara; here, in 1516, appeared the first edition of the "Orlando;" and here, on the 5th of June, 1533, the poet breathed his last. The house in which he lived is still standing. He was buried in the church of the Benedictines; and it is a curious fact that the bust on his tomb being struck by lightning towards the middle of last century, the iron laurels that wreathed the brows of the poet were melted. Tasso is another of the glories, but his treatment is also the shame, of Ferrara. A cell in the lunatic hospital of St. Anna, about nine paces by five or six, and 7 feet high, lighted by a grated window, is shown as that in which the author of the "Gerusalemme Liberata" was immured from March, 1579, to December, 1580, when he was removed to a contiguous and larger apartment. In 1584 his prison was again enlarged; but it was not till 1586 that he was set at liberty, at the intercession of the Duke of Mantua. In one of the dungeons of the castle, at the base of the "lion tower," on 21st May, 1425, the Marquis Nicholas III. caused his faithless wife Parisina Malatesta and his natural son Hugo, her paramour, to be beheaded. Lord Byron in his poem of "Parisina" substitutes the name of Azzo for Nicholas, on account of its being more metrical. Guarini, author of the "Pastor Fido," the Cardinal Bentivoglio, and several other distinguished persons, were natives of Ferrara.

FER'RET (*Putorius furo*) is a domesticated variety of one of the weasel family (Mustelidæ), probably the

POLECAT, to which it is similar in size, form, and habits, and with which it will breed freely. It is, however, a true albino, having a yellowish-white fur and pink eyes. It was brought originally from North Africa, and may be the descendant of a wild species inhabiting that country now extinct. It is about 14 inches in length excluding the tail. Unlike the polecat it is sensitive to cold, succumbing to an English winter unless well looked after. It is kept both in England and in America for killing rats and in rabbit-hunting, in which latter sport the Romans of Pliny's days used to employ it. It can hardly be considered a tame creature, for its disposition is exceedingly capricious; and in handling ferrets, as every ratcatcher knows, a certain degree of boldness and caution is necessary. On one occasion it has been known to attack a child in its cradle, committing fearful injuries in the gratification of its carnivorous tastes before it was disturbed. In rabbit-hunting it is advisable to use a muzzle, otherwise the ferret is very apt, after having feasted on its prey, to lie up in the burrow and disappoint the sportsman.

FER'RIC ACID. See IRON.

FER'ROCY'ANIDES. See CYANIDES, IRON.

FER'ROL, a seaport town of Galicia in Spain, on an arm of the Bay of Betanzos, stands about 15 miles by water N.E. from Corunna, and has 17,000 inhabitants. The harbour is large and safe, and its entrance is defended by strong batteries. It is entered by a channel 2 miles long, having a depth of from 8 to 11 fathoms, but only admitting one vessel at a time, and being commanded by strong forts. The arsenal and dockyards are on a grand scale, and cover 24 acres. The barracks accommodate 6000 men. The town is regularly built, the streets crossing each other at right angles. It has a school of navigation, some manufactures of hats, and carries on a considerable fishery of herrings and sardines, which are pickled and exported.

Ferrol also carries on some trade with America, exporting wine, brandy, and corn. It is the residence of a commandant-general and other chief officers of the naval department.

Prior to 1752 Ferrol was only a fishing hamlet frequented by coasting vessels; but owing to the advantages of its situation it was afterwards made the chief naval station of Spain.

FERRY, an exclusive privilege by prescription or the king's grant for the carriage of horses and men across a river or arm of the sea for reasonable toll. The owner of a ferry cannot suppress it and put up a bridge in its stead without a license; but he is bound to keep it always in repair and readiness, with expert men and reasonable toll, for neglect of which he is liable to be punished by indictment. If a ferry is erected so near to an ancient ferry as to draw away its custom, it is a nuisance to the owner of the old one, for which the law will give him remedy by action. A ferry is considered as a common highway (Blackstone).

FERTILIZATION. Some notion of the sexes of plants appears to have been entertained by observers for many centuries, but it is only very lately that the matter has been put beyond dispute. Herodotus (i. 93) mentions that the palm-growers in the Levant distinguished between the trees which bore fruit and those which bore only flowers, and that they considered it necessary to bring the male flowers into contact with the female flowers in order to produce fruit. And Theophrastus, 100 years later, contrary to the opinion of his master Aristotle, thought the fact sufficiently well established. The distinction was known also among the Romans. It is referred to by Pliny and by Ovid. The loves of the trees and the flowers were often sung by the poets. In the sixteenth century the celebrated Italian botanist Cesalpinus notices the existence of two sexes in several plants in his work "De Plantis," published in 1583; but he had no idea of the true functions of the parts of flowers, for he speaks of a genial effluvium arising from the males, and exciting a stronger fertility in the females. But it was not until the latter part of the seventeenth century that the existence of the phenomenon of vegetable fertilization was brought to light by the researches of Grew, who had for some years been engaged in microscopical investigations, and in 1676 read a paper before the Royal Society pointing to the "dust of the apices" as fecundating the seed-vessel. The celebrated botanist Ray admitted the opinion at first with caution in his "Historia Plantarum," with less reserve in his "Synopsis Stirpium Britannicarum" (1690), and finally in 1694 fully accepted it, giving his reasons in "Sylloge Stirpium Europæarum." Camerarius proved the arguments of Grew and Ray by experiments, the results of which were communicated by him in his celebrated letter to Valentini ("Camerarii Epistola ad Mich. Bern. Valentinum de Sexu Plantarum," Tubingæ, 1694). Linnæus, in his "Dissertation on the Sexes of Plants" (1760), wrote as follows:—"While plants are in flowers the pollen falls from the antheræ, and is dispersed abroad. At the same time that the pollen is scattered the stigma is then in its highest vigour, and for a portion of the day at least is moistened with a fine dew. The pollen easily finds access to the stigma, where it not only adheres by means of the dew of the part, but the moisture occasions its bursting, by which means its contents are discharged. What issued from it, being mixed with the fluid of the stigma, is conveyed to the rudiments of the seed."

Amici, an Italian, in 1822, in observations which he was making on the common purslane (*Portulaca oleracea*), noticed that each grain of pollen in contact with the stigma emitted a tube, which he named the "pollen tube." Brongniart, in his "Generation of Plants" (1826), pointed out the occurrences of the same phenomena in Datura and other plants, and moreover added that the pollen tubes penetrated the style. Since that time investigations with more powerful microscopes have led to a knowledge of the following facts:—

The cell-wall of the pollen-grain becomes differentiated into two layers, an outer (*extine*) and an inner (*intine*). The outer is tough, of the nature of cuticle, and ornamented with spines, ridges, &c. The inner is a very thin, delicate, transparent, and colourless membrane of cellulose. These layers inclose only one cell in Angiosperms; but in Gymnosperms the cells undergo one or more divisions. The contents of the pollen-grain usually consists of a dense coarse-grained protoplasm, in which may be seen starch-granules and drops of oil. When the pollen falls upon the viscid stigma, the moisture is to some extent absorbed, causing the inner layer to grow through one of the weaker spots of the outer into a long narrow tube, which penetrates the channel of the style where there is one, or more usually through the loose conducting tissue in its interior down to the cavity of the ovary. When the micropyle is close to the base of the style, as in erect basilar and in pendulous anatropous ovules, the descending pollen-tube can enter it at once. But more often the pollen-tubes have to undergo further growth after their entrance into the cavity of the ovary before they reach the micropyles of the ovules, and they are then guided in the right direction by various contrivances. Frequently there are projections of the walls of the ovary, hairs, &c., which conduct the pollen-tube to the micropyle. In Gymnosperms it penetrates at once the tissues of the nucleus. It is only when it reaches the embryo-sac (in Gymnosperms, however, it penetrates more deeply) that fertilization of the embryonic vesicle results. The previous process is usually distinguished as *pollination*. A few hours or days elapse between pollination and fertilization, but often months intervene. Pollination is generally followed by great

changes—the stigma, style, and corolla wither, and the ovary swells; in many Orchideæ the ovules are only formed after pollination. Fertilization, strictly, is the entrance of the pollen-tube into the embryo-sac; the embryonic vesicle then develops into the embryo, and in Angiosperms the endosperm is formed (previously in Gymnosperms). The ovule and ovary change sometimes very considerably after fertilization, and become the fruit inclosing the seed.

From the historical sketch it will have been seen that attention was attracted to the subject of fertilization from the fact of male and female flowers occurring separately. Such plants can be fertilized naturally by the wind blowing showers of pollen, or by insects carrying pollen from one flower to another. In 1793 a German botanist, Sprengel, published his work, "The Secret of Nature Discovered in the Form and Fertilization of Flowers." Six years before, seeing that most flowers which contain nectar are so arranged that, while rain cannot reach it, insects can do so easily, he had come to the conclusion that this honey was intended only for insects. Then he discovered in some flowers coloured dots and lines converging towards the nectaries, and these he called the "path-finders" or "honey-guides;" and it began to dawn upon him that the colours of flowers were useful as attractions. Hitherto he had considered that flowers had been contrived simply for the use of insects, but now his views became enlarged, and he thought that he had evidence to show that flowers are fertilized by insects, which, in getting at the honey, brush the pollen from the stamens on the stigma. Noticing that the sexes are separated in so many flowers, and in others that the pollen and stigma of the same flower are matured at different times, he says, "It appears that nature has not willed that any one flower should be fertilized by its own pollen." But he did not perceive the importance of the principle, and in fact scarcely calls attention to it. His theory contained a flaw, for "if the convergence of pollen to the stigma by insects is of no greater advantage than the direct contact of the pollen in the flower, then the preference of the former uncertain method to the latter would seem unnecessary and capricious, and any theory based thereon falls to the ground." Andrew Knight, in 1799, had got upon the right track, for he remarks, "Nature intended that a sexual intercourse should take place between the neighbouring plants of the same species." Others, too, recognized the advantage of fertilizing one flower by pollen from another, but they failed to connect these observations with the discoveries of Sprengel. But Darwin was the first to make it clear that the importance of insects to flowers consists in their carrying the pollen from one flower to a different flower. He has worked out many details in his works, "On the Various Contrivances by which British and Foreign Orchids are Fertilized by Insects," and "The Effect of Cross and Self-fertilization in the Vegetable Kingdom." At the end of the latter he says, "The first and most important of the conclusions which may be drawn from the observations given in this volume is, that cross-fertilization is generally beneficial, and self-fertilization injurious. This is shown by the difference in height, weight, constitutional vigour, and fertility of the offspring from crossed and self-fertilized flowers, and in the number of seeds produced by the parent plants. With respect to the second of these two propositions—namely, that self-fertilization is generally injurious—we have abundant evidence. The structure of the flowers in such plants as *Lobelia ramosa*, *Digitalis purpurea*, &c. renders the aid of insects almost indispensable for their fertilization; and bearing in mind the prepotency of pollen from a distinct individual over that from the same individual, such plants will almost certainly have been crossed during many or all previous generations. . . . The same inferences may be drawn still more surely with respect to those plants, such as Reseda and Eschscholtzia, which are sterile with their own pollen but fertile with that from any other individual. These several plants must therefore have been crossed during a long series of previous generations, and the artifical crosses in my experiments cannot have increased the vigour of the offspring beyond that of their progenitors. Therefore the difference between the self-fertilized and crossed plants raised by me cannot be attributed to the superiority of the crossed, but to the inferiority of the self-fertilized seedlings, due to the injurious effects of self-fertilization."

Darwin's experiments and investigations have been carried on by numerous students, of whom the chief are Hildebrand, Delpino, Fritz Müller, Axell, and Hermann Müller. A translation of Hermann Müller's "Fertilization of Flowers," with a preface by Charles Darwin, was published in 1883. It is a worthy successor to Darwin's own works on the subject. From the general retrospect the following is taken:—

"The lowest and most primitive of the flowering plants have flowers fertilized by the wind. So it would appear that the first adaptations to insect visits were attained in flowers adapted for wind-fertilization, and that wind-fertilized flowers then, as now, received visits from insects. In comparatively few insect-fertilized flowers is the amount of pollen required by the plant itself the sole attraction for insects; the great majority either produce a large excess of pollen or else secrete honey. The fact that many plants secrete honey, even outside their flowers, in which case it does not influence fertilization, renders it probable that the mere excretion of honey is beneficial, and may have begun before all adaptations to insect visits. While all facts go to prove that it is of advantage for flowers to be visited by the utmost possible variety of insects, since the likelihood of cross-fertilization increases with the number of visitors, yet the attraction of all kinds of insects is attended with several disadvantages; for many visitors are positively hurtful, as, for instance, voracious beetles, which may devour the reproductive elements of the flower, and each class of insects will be the less attracted the more the store of food is removed by others, and so we find that the great majority of flowers possess contrivances for more or less restricting certain insect visitors. The concealment of the honey, and also of the pollen, are subjects of special interest. The transition from wind-fertilization to insect-fertilization, and the first traces of adaptation to insects, is due to the influence of quite short-lipped insects with a feebly developed colour sense. The most primitive flowers are therefore for the most part simple, widely open, regular, devoid of honey, or with their honey unconcealed and easily accessible, and white or yellow in colour. The carrion-loving flies were from the first marked out by their peculiar tastes to produce certain peculiar flowers. Preferring those colours and odours which guided them to their primitive food, they produced, whenever they got special influence, dull yellowish or dark purple colours, often accompanied with a putrid smell. The stupidity of flies also favoured the production of such contrivances to insure crossing as is found in the prison flowers of Arum, the traps of the Butterworts or Stapelia, or the deceptions of Paris, Ophrys, and Parnassia. Gradually there arose others, more skilful and intelligent, with longer tongues and acuter colour-sense, and they gradually brought about the production of flowers with more varied colours, with honey invisible to, or beyond the reach of, the less intelligent short-tongued guests, and with various contrivances for lodging, protecting, and pointing out where the honey lay."

FER'ULA, a genus of umbelliferous plants whose species often yield a powerful stimulating gum-resin employed in medicine. Asafœtida is produced by several species of this genus.

Asafœtida is found only in two districts of Persia, that

is, the fields and mountains round Herat, and the range of mountains in the province of Lar. The *Ferula Asafœtida* of Linnæus (*Ferula Scorodosma*) is said to arrive at as great an age as man himself, and in consequence its roots sometimes attain a considerable size. It is from wounds in this part that the drug is obtained. The roots are not wounded before they are four years old; the greater their age, the better the quality of their produce. There were four operations each year when Kæmpfer visited the country; the first in the middle of April, the second at the latter end of May, the third ten days later, and the fourth in the beginning of July. The gatherers on the first occasion only cleared the hard sandy or stony soil away from the root to the depth of a span or so, pulling off the leaves, replacing the earth about the roots, and then heaping the leaves on them, and pressing them down with a stone. On the subsequent occasions they slice the roots transversely, beginning a little below the top, and collecting the juice that flows from the wounds. After every operation they cover the root with the old leaves to screen it from the sun. After the last gathering the roots are left to perish.

FES'CENNINE VERSES were rude extempore verses frequently sung by young men at weddings and before the door of the nuptial chamber. This was a very ancient custom in Italy. The practice, and some of the verses themselves, are said to have been introduced from Fescennium, an old Etruscan town near the present site of Civita Castellana. Horace ("Epist." ii. 1) says that Fescennine verses were sung by the country people at harvest time; and the custom of dealing out licentious jokes upon each other, and upon strangers passing by, is still retained by the vintagers in various parts of Italy. The name has also been thought to have been derived from the Latin *fascinum*, a bewitching, from the custom of chanting as a protection against witchcraft.

FES'CUE GRASS or **FESTU'CA,** a genus of grasses containing several species of agricultural importance. *Festuca pratensis* (or meadow fescue) is about 3 feet high, a native of moist meadows, and forms a portion of most good meadow herbage. In point of early produce this grass ranks next to meadow fox-tail, and is much more productive. *Festuca ovina*, *rubra*, and *duriuscula* are other agricultural grasses, much smaller than the last, and contributing greatly to the value of pastures. *Festuca ovina* has a fine succulent foliage, and, according to Linnæus, sheep have no relish for hills on which it does not abound; it is, however, unproductive. *Festuca rubra* is more abundant in its produce, but less nutritive, and its creeping root-like stems are said to impoverish the soil very much. *Festuca duriuscula* (a variety of *ovina*) is preferable to both the preceding; it withstands dry weather better than most grasses, and in combination with *Festuca pratensis* and *Poa trivialis* forms excellent pasturage. It is most prevalent on light rich soils. In the genus Festuca the glumes are unequal, herbaceous, many-flowered. The lower pale is rounded on the back, very acute, or with the dorsal vein excurrent or just below the tip as a short awn, the lateral veins slightly converging and vanishing below the tip. The upper pale has minute hairs on the ribs. The styles are small and terminal. The nut is furrowed, adhering to the pales.

FESS or **FESSE,** one of the ordinaries in heraldry, is a broad band of metal or colour crossing the shield horizontally, cutting it at one-third of its length. It is usually taken to represent the knight's sword-belt, and the derivation of the word gives colour to this suggestion. It comes from the old French *fesce*, and this from the Latin *fascia*, a girth, akin to *fascis*, a bundle (often girthed round the middle). *Party per fess* is said of a shield horizontally halved; *party per pale*, of a shield vertically halved; *party per cross*, of a shield divided both per fess and per pale.

FESTIVALS, MUSICAL. The great periodical assemblies which form so marked a feature of the music of our time have originated in many independent ways. The first in time is undoubtedly the Festival of the Sons of the Clergy, as it is popularly called, which since the year 1709 has yearly been held at St. Paul's to provide funds for the excellent charity which gives it its name. A full band and choir, chiefly amateur, attends, and an "anthem," often amounting to large selections from an oratorio, &c., is either specially written or arranged. The leading composers take it in turn to provide an original musical service; and most of the principal church choirs in London take part, each choir rehearsing separately and then attending a few full rehearsals.

The next oldest is the famous and popular Festival of the Three Choirs, arising from a laudable desire of joint action between the three cathedral choirs of Hereford, Gloucester, and Worcester. Each city is visited in turn by the choirs of the other two, with other assistants, and performances of oratorio lasting several days are held in the cathedral. Generally some special works are written by leading composers in addition to the usual great classical works performed; and the chief instrumentalists in the orchestral accompaniment, and the foremost singers of the day in the solo parts, combine with the well-trained choirs to keep the west of England fully abreast of the very highest point reached by composers or executants in our day. The conductor is the organist of the cathedral for the year. This festival is held triennially, and its profits are devoted to similar uses with that of the St. Paul's festival. A few years back the clergy of one of these cathedrals endeavoured to reduce the meetings to their original function of a musical assembly for purely church work, on the ground that a performance of sacred music in a cathedral was a desecration, unless it was strictly part of the day's service. The opposition they encountered was so universal that the matter was quickly compromised by some slight religious ceremony being annexed to the oratorio. On the other hand secular performances are held in the evenings in some suitable public room of the city.

The Birmingham Festival is the most important of all these meetings. It is indeed for ever famous as the occasion of the introduction of the oratorios of Mendelssohn, "St. Paul" being first heard here in England in 1837, and "Elijah" being specially written for the Birmingham festival of 1846. Such great honour has not fallen even to the lot of London. The excellent works "Eli" and "Naaman," of Sir Michael Costa, were also commissioned for the Birmingham festivals of 1855 and 1864. The performances are given in the town hall triennially, and date from 1768. Originally the chorus was made up of the choirs of Worcester and Lichfield, with a few helpers; now the band usually numbers nearly 150 and the chorus nearly 400. The finest artistes of the day are always engaged, and it is an honour eagerly accepted by the great conductors of our time to direct the festival. Dr. Crotch, S. Wesley, Mendelssohn, Moscheles, and Sir Michael Costa have in turn conducted. The proceeds go to the Birmingham General Hospital, which has received by this means over £100,000 on the whole. The profits vary greatly. In 1768 they were £299, but they have risen in specially attractive years to as high as £7500.

The Norwich Festival began in 1770, but was at first very irregularly held. Finally Mr. Philip Martineau (a relative of the famous authoress) decided his fellow-citizens to follow the example of Birmingham, and in 1824 the first triennial festival on that scale of magnitude was held with the same success which has attended all its followers. It yielded a profit of nearly £2500, rather over what has since been gained. As at Birmingham the profits go to the hospital (Norfolk and Norwich Hospital). Many fine works have been written for Norwich. The conductors

have numbered among them Sir George Smart, Spohr, and Sir Julius Benedict, who produced his elegant cantata of "Undine" at Norwich in 1860, and his oratorio "St. Cecilia" in 1866.

The Leeds Festival (also a triennial festival, and also giving its proceeds to the hospitals of the town) dates from 1858, when the town-hall was opened by the queen, and Sir W. Sterndale Bennett produced the exquisite work "The May Queen," which stands deservedly at the very head of all cantatas. Sir George Macfarren's "Joseph" was also a commission for Leeds (1877). Sir Michael Costa was usually the conductor while he lived.

Other great musical festivals are those of Bristol, of York, and of Liverpool, held with less regularity but with no less splendour than the foregoing. Edinburgh, Glasgow, and Dundee also hold festivals of considerable importance.

The Handel Festivals are of colossal magnitude and entirely *sui generis*. They have been held triennially at the Crystal Palace, Sydenham, near London, since 1859 (the centenary of Handel's death); and the vast chorus of considerably over 3000, and the band of about 400, with the powerful organ, all collected in a domed hemispherical orchestra, the largest in the world, unite to impress the hearer with a feeling of awe as they give forth some of Handel's mighty choruses. The vast assemblage, the great roll of sound, and the grand simple effects, of which one never tires, and which lend themselves so readily to this massive treatment, cannot be equalled in the world. The combination is peculiarly English in every way. This festival grew out of a Handel commemoration held in Westminster Abbey in 1784, ninety-nine years after Handel's birth and twenty-five years after his death. The orchestra and chorus numbered 525, and the body of sound was considered stupendous. The performances were repeated in several successive years; and the tradition of the success with which Handel's music had borne such massive handling inspired the managing director of the Crystal Palace (Mr. Bowley) with the idea of eclipsing the Westminster Abbey celebration. But for fear of failure a preliminary festival was held in 1857, and at once dispelled all doubt on the subject by its magnificent success. The great festival followed in 1859, and since then festivals have been held triennially, in the month of June. The "Messiah" always opens the festival, and "Israel in Egypt" usually closes it. These are on Monday and Friday, Wednesday being filled by a selection from other works of Handel. The festival week is preceded by a general rehearsal held on the Friday of the week before. Sir Michael Costa conducted up till 1883, when Mr. Manns took his place. The audience, as seen from the orchestra, is a wonderful sight, spreading as far as the eye can reach in countless thousands.

FESTOON' (from Lat. *festo*, *festonis*, a garland, probably from *festis*, a ridge, a Late Latin word), a garland of fruit or flowers, hanging in suspended curves from points at equal distances. Sculptured in stone the festoon is a favourite ornament in the architecture of the classical renaissance, and is also, though sparingly, employed by the Greeks and Romans themselves.

FES'TUS, POR'CIUS, succeeded Antonius Felix as procurator of Judea A.D. 62; and having brought Paul to judgment, honourably accepted his appeal to the emperor and sent him to Rome. Festus died shortly afterwards. As Agrippa, king of Judea, said, Paul might have been set at liberty had he not appealed to Cæsar, for both he and Festus plainly saw his innocence.

FESTUS, SEXTUS POMPEIUS, a Latin grammarian of the fourth century. He compiled an epitome of the voluminous work "De Verborum Significatione" of Marcus Verrius Flaccus, a grammarian of the Augustan age mentioned by Suetonius. The work of Verrius is lost, and that of Festus was afterwards abridged in the ninth century by Paulius Diaconus. The best edition of Festus is by K. O. Müller (Leipzig, 4to, 1839).

FETIA'LES or **FECIA'LES,** in ancient Rome, were the messengers or heralds of war and peace; they belonged to the order of the priesthood. They were employed in demanding satisfaction for wrongs done to the Roman state, in declaring war, and in making peace. The rules which regulated their duties formed the *jus Fetiale*, a kind of law of nations in the modern sense. They were about twenty in number, and held their important office for life, being chosen from the greatest families. As Mommsen justly points out, they occupied the same position with regard to international law as the pontifices did with regard to the religious law; that is, they expounded it, but did not carry it into execution.

FET'ICHISM, among the negroes of Western Africa, is the worship of idols, or of any material object which whim or fancy may temporarily select, the value of whose power is measured by the luck or ill luck that attends the worshipper. Thus if ill luck on a journey attends a New Guinea negro, he lays the blame of it on the fetich he had chosen at the start, calls it all the bad names he can command, and destroys it if his luck does not change; should it change he seeks the fetich's pardon with the most profuse apologies. This may be considered as the lowest and most degrading kind of superstition to be found in the human family. The negroes' fetich consists of mere stones, plants, vessels, weapons, or shells. Tribes, families, and individuals have their peculiar fetiches, which are generally selected under the influence of some superstitious notion with which reason has no concern, much in the same way that modern superstitions, such as a belief in the luck attending a crooked sixpence or a horse-shoe nailed to the door, are extant in Europe. The term is derived from a Portuguese word, *feitiço*, meaning sorcery.

Fetichism, carefully examined, is indeed not a religion at all, but a species of witchcraft. Just as the sorceress of the middle ages, by taking a waxen image of a person, could stick needles in it or roast it at a slow fire, and produce similar effects upon the victim himself, so the negro catching up his ear of corn, his stone, or what not, runs the chance of capturing a powerful spirit. Beating the corn he beats the spirit, and forces him to his will. If he finds nothing comes of the beating, clearly he has either selected a spiritless object, or the spirit is unable to perform the task desired. The fetich is in no case adored or worshipped.

Fetichism, though the term began with the negroes, can now no longer be limited to Africa. Every year adds to the number of savage nations discovered to be fetichists. The Badagas of Hindustan are almost identical with the Guinea negroes in their practices, and the Ostiaks of Siberia closely resemble them. The North American Indians have their "medicine-bags," which Catlin long ago described. The redskin boy wanders out alone on the prairie till he drops with fatigue and hunger, and whatever animal he dreams of in the trance of exhaustion becomes his medicine. He kills it as soon as he can, makes a bag of its skin, and regards it as a fetich. Unlike the negro, however, he never changes his fetich.

Finally, we quote from the graphic account of the lower orders of China in Astley's "Collection of Voyages," as given in Sir John Lubbock's "Origin of Civilization." If after long praying to an image they do not gain what they desire they will cry aloud to him, with bitter reproaches, "How now, dog of a spirit! we give you a lodging in a magnificent temple, we gild you handsomely, feed you well, and offer incense to you; yet after all this care, you are so ungrateful as to refuse us what we ask of you." Hereupon they tie this image with cords, pluck him down, and drag him along the streets through all the mud and dunghills, to punish him for the expense of perfume which they have

thrown away on him. If in the meantime it happens that they obtain their request they wash him clean, carry him back with a great deal of ceremony, and place him in his niche again, making the best excuses they may. "It is true we were a little too hasty," they allege, "as well as you were somewhat too long in your grant. Why should you bring this beating upon yourself? But what is done cannot now be undone; let us not therefore think of it any more. If you will forget the past, we will gild you over again." This is as pure fetichism as anything in western Africa. For a kindred superstition see TOTEM.

The transition from fetichism to idolatry is most probably explained as follows:—It seems likely that some form of fetichism has prevailed very extensively in the earlier history of our race; and that from a stone being cherished as a fetich or means of controlling a spirit, it would naturally come, if a lucky fetich, to be adored as the home of a spirit. While still the sense of a common nature, like his own nature, existing in all things is present to the savage, a rude stone is as good an object of worship as any other, for it is just as much akin to man as is everything else. But as man's sense of separation from the outer world waxes clearer, the worshipped stone needs to receive some rough likeness to the human form. Thus, as Pausanias says, the oldest Greek worship was that of rough stones. Then came such rude *zoana* as the pear-wood image of Hera, which the Proetides mocked at when art and consciousness had made a still further advance. But of course the conservative priesthoods retained the rough stones called Zeus, or Eros, alongside of the rude *zoanon*, the image made of nailed plates of bronze, the archaic statues, and the fully-developed works of Phidias, and held all in equal reverence.

FEU. Land, houses, &c., held in perpetuity under a feu charter, subject to an annual feu-duty in money or kind, together with certain contingent burdens on succession, &c., constitute the Scottish relic of the feudal system which answers to the leasing system of England. The feuar being secure in his feu usually feels able to deal more freely in the matter of enriching farms or of building enduring structures than his English neighbour, who, if he does such things, works for his landlord rather than for his children. Feu-duty is paid in money, and if by the charter it should be paid in grain the FIARS scale of the year is used for settling the money value. If the feuar does not pay his duty for two years the feu lapses to the superior. The feu system may be compared to the Irish tenant-right.

FEUDAL SYSTEM. The essential constituent of the estate called a feud or fief was, that it was an estate held only on the condition of the performance of certain services to the lord, who retained his absolute ownership. The etymology of the word *feud*, *feof*, *fief*, *fee* has been much discussed. It is probably from the Teutonic *fihu* (*vieh*), cattle, *i.e.* property. The system of feudalism probably followed a course of progressive development. From the commencement it comprised the notion of a tenant who owed services for his land, and that of vassal, which denoted a personal relation to the lord. It appears to be certain that the original *vassali* or *vassi* were merely noblemen who attached themselves to the court and to attendance upon the prince, without necessarily holding any landed estate or *beneficium* by royal grant. *Vassal* has been derived from the Celtic *gwas*, and from the German *gesell*, which are probably the same word, and of both of which the original signification seems to be a helper or subordinate associate in labour of any kind.

If the vassal was at first merely the associate of or attendant upon his lord, nothing could be more natural than that, when the lord came to have land to give away, he should most frequently bestow it upon his vassals, both as a reward for their past and a bond by which he might secure their future services. The vassal was conveniently and appropriately rewarded by a fief, that is, by a loan of land, the profits of which were left to him as entirely as if he had obtained the ownership of the land, but his precarious tenure of which, at the same time, kept him bound to his lord in the same dependence as before.

When fiefs for life became established, the next step would be for the eldest son usually to succeed his father. His right so to succeed would next be established by usage. At a later stage fiefs became descendible in the collateral as well as in the direct line. At a still later they became inheritable to females as well as to males. There is much difference of opinion, however, as to the dates at which these several changes took place. Some writers conceive that fiefs first became hereditary in France under Charlemagne; others, however, maintain that there were hereditary fiefs under the first race of French kings.

Originally fiefs were granted only by sovereign princes; but in course of time tenants began to exercise the power of lords by the practice of what was called subinfeudation, that is, the alienation of portions of their fiefs to other parties, who were placed in the same or a similar relation to them as that in which they stood to the prince. The vassal of the prince became the lord over other vassals; in this latter capacity he was called a *mesne* (that is, an intermediate) lord; he was a lord and a vassal at the same time. In the same manner the vassal of a mesne lord might become also the lord of other *arrere* vassals, as those vassals that held of a mesne lord were designated.

In all the continental provinces of the Roman Empire which were conquered and occupied by the Germanic nations, many lands were from the first held, not as fiefs, but as *allodia*, in full and entire ownership. After the conquest of England by the Normans, the *dominium directum*, or property of all the land in the kingdom, was considered as vested in the crown, and there were no allodia. There were also various other differences. The Conqueror, for instance, introduced here the practice, unknown on the Continent, of compelling the arrere vassals, as well as the immediate tenants of the crown, to take the oath of fealty to himself. Other differences were the customs of wardship or guardianship of the tenant during minority, which implied both the custody of his person and the appropriation of the profits of the estate, and the right of marriage (*maritagium*), which originally implied only the power possessed by the lord of tendering a husband to his female ward while under age; if she rejected the match, she forfeited the value of the marriage, that is, as much as anyone would give to the lord for permission to marry her. This right was afterwards extended so as to include male as well as female heirs. The seigniorial prerogative of marriage and that of wardship was peculiar to England, Scotland, Normandy, and some parts of Germany.

The grant of land as a fief, especially when it was a grant from the suzerain or supreme lord, whether called king or duke, or any other name, was generally accompanied with an express grant of jurisdiction. Thus every great tenant exercised a jurisdiction civil and criminal over his immediate tenants; he held courts and administered the laws within his lordship like a sovereign prince. It appears that the same jurisdiction was often granted by the crown to the abbeys with their lands. The formation of manors in this country appears to have been consequent upon the establishment of feudalism.

In the infancy of the feudal system it is probable that the vassal was considered bound to attend his lord in war for any length of time during which his services might be required. Afterwards, when the situation of the vassal became more independent, the amount of this kind of service was fixed either by law or by usage. In England the whole country was divided into about 60,000 knights' fees; and the tenant of each of these appears to have been

obliged to keep the field at his own expense for forty days, on every occasion on which his lord chose to call upon him. Women were obliged to send their substitutes; and so were the clergy, certain persons holding public offices, and men past the age of sixty, all of whom were exempted from personal service.

There were, however, various other substantial advantages derived by the lord, such as the payment, called a relief, made by every new entrant upon the possession of the fief, the escheat of the land to the lord when the tenant left no heir, and its forfeiture to him when the tenant was found guilty either of a breach of his oath of fealty or of felony. There was besides a fine payable to the lord upon the alienation by the tenant of any part of the estate, if that was at all permitted. Finally, there were the various aids, as they were called, payable by the tenant. The principal ceremonies used in conferring a fief were homage, fealty, and investiture.

The conquest of England by the Normans placed the whole land in the hands of the crown, and it was soon granted to be held in fief by the vassals of the crown, or of them by subinfeudation. Those lands which the king kept as crown property were called his demesne (the *terræ regis* of the Domesday Survey). See FOLC-LAND.

Feudalism, in its strict form, clearly could only be of temporary utility, and it soon began to be modified. For instance, the feudal military army was at length found so inconvenient a force that soon after the accession of Henry II. the personal service of vassals was dispensed with, and a pecuniary payment, under the name of escuage, accepted in its stead. The acquisition by the crown of an army of subservient mercenaries, in exchange for its former inefficient and withal turbulent and unmanageable army of vassals, was in fact the discovery of a substitute for the main purpose of the feudal polity.

The effect of subinfeudation was to deprive the lord of his forfeitures and escheats and the other advantages of his seigniory, and various attempts were made to check or prevent it. It is expressly forbidden by the statute of Quia Emptores (the 18 Edward I. c. 1). Subinfeudation was originally the only way in which the holder of a fief could alienate any part of his estate without the consent of his lord, and as a compensation for the prohibition of subinfeudation the old prohibition against alienation was removed, and lands were allowed to be alienated; the purchaser or grantee did not hold them of the vendor or grantor, but held them exactly as the grantor did, and such is still the legal effect in England when a man parts with his entire interest in his lands. This change was effected by the statute of Quia Emptores with regard to all persons except the immediate tenants of the crown, who, by the statute 1 Edward III. c. 12, were permitted to alienate on paying a fine to the king.

It was a consequence of feudal principles that a man's lands could not be subjected to the claims of his creditors. This restraint upon what may be called voluntary alienation has been removed by the successive enactments which have had for their object the making of a man's lands liable for his debts, although it was only after a lapse of nearly 600 years from the statute of ACTON BURNEL that the lands of a debtor were completely subjected to the just demands of his creditors.

An attempt was made to restore in part the old restraints upon voluntary alienation by the statute 13 Edward I. c. 1, entitled De Donis Conditiónalibus, which had for its object the enabling of any owner of an estate, by his own disposition, to secure its descent in a particular line. The effect was to create what were called estates tail. The power which was thus conferred upon landholders of preventing the alienation of their lands remained in full force for nearly two centuries, till at last, in the reign of Edward IV., by the decision of the courts (1472) the practice of barring estates tail by a common recovery was completely established.

The restraint on the disposition of lands by will was removed in the reign of Henry VIII. (statute 32 & 34 Henry VIII.), and all persons were allowed to dispose of their freehold lands held in fee-simple by a will in writing, subject to certain restrictions as to lands held by knight-service either of the king or any other, which restrictions were removed by the statute 12 Charles II. c. 24, which abolished military tenures.

The fabric of the feudal system in England, however, was finally shattered by the storm of the great rebellion. The Court of Wards was in effect discontinued from 1645. The restoration of the king could not restore what had thus been in practice swept away. By the 12 Charles II. c. 24, it was accordingly enacted that from the year 1645 the Court of Wards and Liveries, and all wardships, liveries, primer-seisins, values, and forfeitures of marriage, &c., by reason of any tenure of the king's majesty, or of any other by knight's tenures, should be taken away and discharged, together with all fines for alienations, tenure by homage, escuage, aids pur filz marrier and pur fair filz chevalier, &c.; and all tenures of any honours, manors, lands, tenements, or hereditaments, or any estate of inheritance at common law, held either of the king or of any other person or persons, bodies politic or corporate, were turned into free and common socage, to all intents and purposes.

In Scotland the feudal system gradually established itself after the example of England, but seems never to have attained the same completeness and oppressive rigour. In Orkney and Shetland it never entirely superseded the udal rights. As in England, subinfeudation was prohibited by 2 Robert I. c. 24; but this was disregarded, and the practice has always been common and is at present *in viridi observantiâ.* Prior to 1747 the land tenure in Scotland had come to be reduced to ward, feu, and blanch, the former being very similar to the military tenure of England, the two latter somewhat resembling common socage and copyhold, and amounting in effect to leases in perpetuity, at real or nominal rents, and with fines at entry of heirs or successors. In that year, by 20 Geo. II. c. 43, and c. 50, ward-holding with all its incidents was abolished; rights so held were converted into feu or blanch, as the case might be, and the respective rights of superiors and vassals were placed on more equitable grounds. The fundamental principles of feudalism, however, remained intact, nothing beyond the military element and its adjuncts being eliminated, and to this day they accordingly remain the basis and test of all land rights other than leasehold. It is noticeable, however, that by various statutes passed in the present century everything oppressive has been eliminated from the existing feudalism, which in combination with registration of titles now forms an easy and effective means of ascertaining and transmitting real property. In like manner estates tail in Scotland may now be entirely relieved from the fetters of a destination in perpetuity by a statutory process in which the interests of all concerned are determined and provided for. See ENTAIL, LAND.

FEUILLANS, a reformed branch of Cistercians, taking their name from that of the convent where the movement originated, during the times of the Reformation. Henry III. of France invited the new body, all aflame with austerity, to Paris, and lodged them in the Rue St. Honoré. In the French Revolution their old convent became the home of the Feuillans Club. It adjoined the Assembly. Lafayette, Sièyes, and other moderate men, especially those who desired an imitation of the English constitution, joined this club. In March, 1791, the club was violently dispersed by a revolutionary mob. When the royal family fled from the Tuileries before the rioters of 10th August, 1792, leaving behind them the Swiss Guards without instructions to retire, and consequently devoting those brave

men needlessly to death, they were placed by the Assembly in the Feuillans for safety. Subsequently they were removed to the Temple prison, which they left only to die.

FEVER (*Pyrexia*) may be defined thus:—After a preliminary stage of languor, weakness, defective appetite, and some degree of chilliness or shivering, there is preternatural heat of body, increased waste of tissue, acceleration of pulse, great muscular debility, and disturbance of most of the functions. A large number of diseases in which all, or some, of these symptoms appear are frequently called fevers. These may be divided into four classes, which, with their subdivisions, are as follows:—

Class I.—Eruptive Fevers, including small-pox, cow-pox, vaccination, chicken-pox, miliary fever, measles, scarlet fever, erysipelas, plague.

Class II.—Continued Fevers, including typhoid or enteric fever, typhus fever, relapsing fever, simple continued fever, specific yellow fever.

Class III.—Malarial or Paludal Fevers, including intermittent paludal fever or ague, remittent paludal fever, malarious yellow fever.

Class IV.—Mucous Fevers, including influenza, hooping cough, diphtheria, croup, dysentery, diarrhœa, cholera.

Most of these various fevers will be considered under their own particular headings. The diseases, however, which in this country are most often included under the general term "fever" are three in number, and they are entirely distinct from one another. *Typhus fever* is a malady which is fatal in a large percentage of cases, and is liable to spring up wherever human beings are crowded together in circumstances of misery and destitution. It is the "gaol fever" of the middle ages, and the fever which follows after the ravages of famine or of war. It is directly and in a high degree contagious, through the medium of the atmosphere, by the exhalations thrown off by the skin and in the breath of the patients. Its contagious character is greatly intensified by the aggregation of the sick, but by the adoption of proper measures of precaution the fever may be confined within a limited area. The most effectual of these measures are an abundant supply of clean, pure air, by which the poison may be oxidized and destroyed, or diluted until it ceases to be operative; the removal of the secretions of the skin by frequent sponging of the surface and by frequent changes of bed and body clothing; and the *immediate* disinfection in chemical solution of all articles which have been in contact with the patient. Typhus seldom occurs except among the poorer classes in densely populated places, and only exceptionally affects those who are able to command moderate ease and competence of living.

Relapsing fever is a disease very different from typhus in its course and character, but which appears to resemble it in the conditions of its diffusion. It occurs in great cities as an occasional epidemic, which is usually traceable to contagion derived from some foreign country, but which, when once established, is often obstinate. Relapsing fever rarely kills, and the principles of prevention which apply to typhus are those by which it must be controlled.

The third form—*typhoid* or *enteric fever*—is the common fever of this country, which spares neither age, sex, nor social condition; which destroyed the life of the Prince Consort, and nearly destroyed that of the Prince of Wales; which destroys from 10,000 to 12,000 people annually, and which sickens and endangers about 100,000 more. It is essentially an eruptive disease of the lining membrane of the intestines—a sort of small-pox which affects the bowels instead of the skin; and, like some other eruptive diseases, its destiny is to run a definite course over a stated period of time. It is spread abroad chiefly, and probably exclusively, by the discharges from its specific eruption, that is to say, by the discharges from the intestine. These, in the natural course of things, find their way into cesspools and sewers, and when they do so they render poisonous the solid or liquid contents of these receptacles, and also the gas which is evolved from them. The fever is then reproduced mainly in three ways—first, by the poisoned sewage obtaining direct access to the drinking water by leaking or soaking, and so being swallowed; secondly, by the poisoned gas escaping from sewers into water mains or cisterns so that it is absorbed or dissolved by the water, and so swallowed; thirdly, by the poisoned gas making its way through badly-trapped drains or other channels, into dwelling or sleeping rooms, and so being breathed by the occupants. To one or other of these methods of diffusion every outbreak of typhoid fever may be referred, and nearly every single case; the tendency of modern research and increased knowledge is to bring exceptions within the general rule. Hence two things are manifest—first, that typhoid fever is very little infectious in the ordinary sense, or through the atmosphere which surrounds the patient; secondly, that it is very actively infectious through concealed channels of indefinite length or tortuousness, so that B may derive his fever directly from A, of whose very existence he is ignorant. The connections which constantly exist between sewers or cesspools and the water or air supply of dwellings, however disagreeable or disgusting, are harmless, as far as the production of typhoid is concerned, until the sewers or cesspools have themselves received the typhoid poison.

After investigating the history of several well-known outbreaks of typhoid fever within recent years, Professor Tyndall came to the conclusion that the disease was purely of a contagious nature; that the worst-drained country villages in the surrounding district escaped so long as the specific poison kept away, and were only attacked when, by some means or other, that poison was conveyed to them. Ashpits failed to develop it, putrescence failed to develop it, stench failed to develop it; even the open privy was powerless so long as it was kept free from the discharges of those already attacked. The following were the precautions adopted by Dr. Budd on the occasion of a violent outbreak of typhoid fever, and the best evidence of their value is that they proved thoroughly effectual. They were, (1) Flooding all the drains of the place with disinfectants, with a view to destroy as far as possible the poison already cast off; (2) the reception of all discharges from the sick immediately on their issue from the body into vessels charged with disinfectants; (3) the instant immersion of all bed and body linen used by the sick into a disinfecting liquid before its removal from the ward; (4) scrupulous ablution and disinfection of the hands of the nurses; and lastly, the burning or disinfection of all beds occupied by the sick as soon as vacated by death, convalescence, or otherwise.

As typhoid may be assumed, for all practical purposes, to spring only from antecedent typhoid, it follows that the form of cleanliness which can be effectual against typhoid has reference only to intestinal discharges. The typhoid patient is harmless except through this single medium, and if the poisonous character of the discharges was in all cases destroyed by chemical agency before they were cast away, the disease would speedily, as far as our present knowledge of its nature enables us to predict, disappear out of the land. But it is obvious that all the precautions as to cleanliness, ventilation, &c., which are necessary and sufficient in the case of typhus, would leave typhoid free to diffuse itself unchecked.

The disease called *scarlet fever* is seldom confounded with either of the three above-mentioned, since it differs from them by well-marked external characteristics. It differs no less in its manner of propagation, which is mainly, if not entirely, by the particles of skin which peel off from the surface of the body during the decline of the malady, and are liable to be scattered far and wide, or to be

retained for an indefinite time in clothing, as a dry and poisonous dust. Here again the special peculiarity of the infection calls for special precautions, one of the most important of which is the frequent oiling of the surface, so that the skin particles may be held prisoners until they are removed by washing.

Each of the four fevers to which we have specially alluded are of the class known as "remittent"—that is, those which exhibit a decided remission in violence during the twenty-four hours, but without entirely leaving the patient, in which they differ from "intermittent" fevers or agues. The disease in the latter cases consists of paroxysms or periods of fever, with perfect intermissions or periods without fever. Marsh miasmata, or the effluvia arising from stagnant water or marshy ground, when acted upon by heat, are the most frequent causes of this malady. For the prevention of ague in situations where it prevails endemically, small doses of quinine should be taken two or three times a day, and flannel clothing should be constantly worn. See AGUE.

The usual symptoms of incipient fever (febrile symptoms) are—chilliness (varying from a simple shiver to a sensation of cold water running down the back), a quick pulse, hot and dry skin, or flushing, languor, often evinced by yawning, depression of spirits, alternate fits of shivering and heat, hurried and uneasy respiration, flying pains in various parts of the body, as the head, back, and loins; loss of appetite, nausea or vomiting, dry mouth, furred tongue, costiveness, urine small in quantity and usually of a deep colour, &c. When any of these symptoms appear their progress may sometimes be arrested by the timely administration of an emetic, followed by a saline purgative and diaphoretics, at the same time promoting the action of these remedies by a low diet and drinking copiously of diluents, and carefully avoiding animal food, spirits, fermented liquors, or anything at all stimulant. Whenever symptoms of fever become established medical aid should be sought.

In visiting or attending persons labouring under fevers, it is advisable to avoid immediate contact with them or their clothing, or standing near them in such a position as to inhale their breath or the effluvia evolved (in some cases) by their bodies; and when remaining for some time in the apartment, it is preferable to sit or stand near the fireplace, or between the window and the door, as such parts of the room are generally better ventilated than the other portions. The greatest purifier of the atmosphere of a sick chamber is a good fire, because it occasions a continual current of the impure air up the chimney, and a corresponding influx of fresh air from without. Chloride of lime or chloride of zinc, or their solutions, are good purifiers. The first, however, should not be used in great quantity, as the evolved chlorine might in that case impede the respiration of the patient. It is also advisable to avoid entering the room of a patient labouring under contagious diseases of any class when the stomach is empty or the spirits depressed, and the mouth should be cleared of the saliva immediately after quitting the chamber.

From what we have said it will be clear that no amount of general knowledge or of vague notions about cleanliness can replace the particular knowledge which begins with accurate discrimination of the sources of danger, and which includes special information about the natural history and the mode of propagation of the malady which is to be prevented or is to be suffered to die out. The value of the hospitals for infectious diseases, which all sanitary authorities are now empowered to establish in the localities under their jurisdiction, must mainly depend upon their affording the necessary means and appliances, guided by the necessary knowledge for checking the natural tendency of such diseases to propagate themselves among the healthy and to increase in prevalence in ever-widening circles.

FEZ or **FAS**, the most industrious and commercial town of the Empire of Morocco, is situated in a valley 240 miles N.E. of the city of Morocco. It is the holy city of the empire, one of the three residences of the sultan, and is supposed to have been founded in 800. There are said to be 360 mosques, the chief of which has 300 pillars and numerous fountains, and in its tower are globes and astronomical instruments. It was built by the sultan Muley Edris, and contains his tomb. It is considered so sacred that once gained by even the greatest criminals it is an inviolable refuge, and it can boast of the singularity of having a covered place for women who may choose to participate in the public prayers—a circumstance unique in Mohammedan places of worship. Fez is the seat of a university, and contains numerous schools. The population has been estimated at 80,000. The manufactures comprise carpets, morocco leather, woollens, silks, jewelry, saddlery and earthenwares. Every trade is carried on in a separate street; generally only one kind of goods is sold in each shop. The commerce of this town with the seaports is very great. The streets are narrow, and owing to the great height of the houses also dark.

Fez was founded in 793 by Edris II., a descendant of Mohammed, and continued the capital of an independent kingdom till 1548, when it was, together with its territory, conquered and annexed to Morocco. After a period of decline it again rose to prosperity on the ruins of the Moorish kingdom of Cordova, and its population became afterwards still further augmented by reason of the edicts of Philip II. against the Mohammedans. It has been always held so sacred by the Arabs and others, that when the pilgrimages to Mecca were interrupted in the tenth century, the western Moslems journeyed to Fez as the eastern did to Jerusalem. The small red cap called the "fez" so generally worn by Mohammedans takes its name from this city, where it was first manufactured.

FEZZAN′, a country in Northern Africa, between 24° and 31° N. lat. and 12° and 18° E. lon., forming a kaïmakamlik of the Ottoman vilayet of Tripoli. It may be considered as the greatest oasis of the Sahara, by which it is inclosed on the west and east, and partly also on the south. On the north it borders on a less desert region, which belongs to the regency of Tripoli. Its northern part chiefly consists of bare black quartz sandstone hills; south of which are sandy plains and a few valleys capable of cultivation, between low hills. As there are no rivers or brooks, and only very few natural springs, the irrigation is effected by wells, water being commonly found at a depth of about 100 feet. The heat in summer is very great, and the cold in winter very often 8° or 10° below freezing-point. The chief products are dates, wheat, barley, and doura. Goats, asses, cows, sheep, horses, and camels are met with.

The chief resides in Mourzouk, the capital, and styles himself sultan, but he is designated sheikh in transactions with Tripoli. The other principal town is Sockna, 230 miles N.N.E. of Mourzouk. Fifteen miles north of it there is a range of hills on the Tripoli border, southwards of which no dew falls; but there are occasional rains, after long intervals. South of Sockna there is a range of black basaltic hills, Gebel-el-Assond or Black Haratsch Mountains, 1200 to 1500 feet high. The plains near these are covered with loose pebbles of white quartz, singularly contrasting with the shining black basaltic rock. The hills are crossed by a gorge. The hills on the east are called Warrirat, composed of red and shining white sandstone, in broken tabular and isolated castle-like forms, but not exceeding 1000 feet above the plain. They range south-east into the Tibboo country, and on the north-west unite with the Black Haratsch.

Fezzan is of some importance in a commercial point of view, being the most frequented road by which Soudan

communicates with the countries along the Mediterranean. The industry of the inhabitants is limited to the manufacture of coarse blankets, which form the principal dress of the lower classes. There is a considerable trade in slaves, about £18,000 annually changing hands at Mourzouk in this traffic alone.

Fezzan is the *Phazania* of the ancients; it was also known as the country of the Garamantes. It was conquered by the Romans under Cornelius Balbus soon after the Christian era. In the seventh century it fell under the dominion of the Arabs, but in 1300 a portion of it was tributary to the Soudan state of Kanem. Soon afterwards a family of the Sherifs (descendants of Mohammed) took possession of it, and held it till 1811, when the bey Mukni usurped the throne. The Turks obtained possession of the country in 1842.

FI'ARS, the price-list of the various grains for the last harvest, fixed by Scotch sheriffs at the end of February on the report of a specially qualified jury. Somewhat as the well-known tithe averages are used for tithe commutation in England, so the fiars are used for payment of ministers' salaries and of other dues payable in kind in Scotland; but the tithe averages of England are based upon the *seven* previous harvests, the fiars of Scotland upon the *one* previous harvest alone. Paterson's "Historical Account of the Striking of the Fiars" is an excellent work on this curious subject (Edinburgh, 1852).

FI'BRE, FI'BRIL. The fibres of muscle and of connective tissue (sometimes splitting up into fibrils) are the ultimate constituents of those substances. Each fibre is a metamorphosed cell, with the further modification, in the case of striped muscle fibres, of a multiplication of the cell-nuclei. The various fibres and fibrils of connective tissue all spring from the homogeneous intercellular substance; but this changes greatly in the different tissues, both chemically as well as physically, until the common origin of structures so diverse can hardly be believed.

FI'BRIN, a principle which is contained in the bodies of animals both in a fluid and a solid state; in the fluid state its elements exist in the blood, and in the solid state it forms muscular fibre. The fibrin of the blood is best obtained by what is called whipping the blood; that is, by rapidly stirring a quantity of fresh-drawn blood with a spoon or a piece of stick. During this process the blood coagulates, and the coagulum adheres to the spoon or stick. The red corpuscles of the blood which are mixed with this coagulum may be removed by washing it in large and repeated portions of water, and afterwards treating it with ether. What remains is nearly pure fibrin.

It must not, however, be thought that the living blood contains fibrin as such. If coagulation be delayed, by cold or the addition of salt to the blood, &c., no fibrin forms, and none will form till the cold is removed or the salt blood diluted. It is evident from these and other considerations that the formation of fibrin is the cause of the coagulation of the blood, and that fibrin is only formed in the act of coagulation. If the fluid of blood be obtained uncoagulated, but devoid of its red corpuscles (which sink to the bottom if not entangled in the meshes of the fibrin in coagulation), and if this *plasma*, as it is called, be diluted, it will coagulate; or if treated with sodium chloride it will throw down a white sticky precipitate, called *plasmine*. Plasmine is soluble in neutral saline solutions, and when so dissolved the product will coagulate. Plasmine is not fibrin, for the latter is either not soluble or but slightly so in such solutions. But it is now almost universally held that plasmine becomes fibrin in the act of coagulation.

When blood has clotted, that is to say, has thrown down fibrin, and the red corpuscles are entangled in the fibrinous meshes, this clot, at first filling the whole vessel into which the blood was poured, shrinks after some hours, squeezing out from itself a yellowish fluid, in which it floats. This is called the *serum* of blood. (Perhaps to be clear it is better to say that the blood is composed of fluid plasma, and solid corpuscles floating in it—that when the fibrin is thrown down from the plasma the remainder of the plasma is the serum.) The serum manifestly is not coagulable, since it has lost its fibrinous formative elements. Also certain serous fluids, as that of hydrocele (a kind of local dropsy), are sometimes formed in the body which cannot coagulate. But if serum and hydrocele fluid be mixed coagulation at once ensues, and fibrin is produced. Now from serum a precipitate can be obtained, called paraglobulin or *fibrino-plastin*; and from hydrocele fluid a kindred precipitate can be obtained, called *fibrinogen*. If a neutral saline solution of fibrino-plastin be added to one of fibrinogen, the mixture cannot be distinguished from the similar solution of plasmine (obtained direct from the plasma of the blood, as spoken of above) either before or after coagulation. Therefore it seems clear that plasmine contains these two elements, and that their union causes fibrin. Schmidt has shown great reason for believing that this union is brought about by a third principle, which is provisionally called the *fibrin-ferment*.

Why, then, does not fibrin form in the living blood? If the blood contains fibrino-plastin, fibrinogen, and fibrin-ferment, why does it remain fluid? To this question the answer is not quite ready; but the fact that the blood in the body long remains fluid after death shows that the surface of the living tissues is one retarding cause; indeed a vessel can be removed from the body and keep its contained blood fluid for a long time if it is well closed. Besides, it is well known that an injury to the surface of the tissues causes blood to clot internally. Also it seems highly probable that the fibrin-ferment does not exist in the plasma, but is the product of the disintegration of the *colourless* corpuscles of the blood, which break down directly the blood is removed from the body. Fibrin-ferment being set free by the dying colourless corpuscles at once acts on the plasma, and the two constituents of fibrin rush together in combination, and fibrin is thrown down.

The fibrin of the flesh was formerly considered to be identical with the fibrin of the blood, but it is now shown to be a distinct variety, called *myosin*—a third variety, called *globulin*, being yielded by the lens of the eye. To obtain the myosin of a muscle it must be finely minced, and washed in repeated portions of water at 60° to 70° till all colouring and soluble substances are withdrawn, and till the residue is colourless, insipid, and inodorous. This may be dissolved by a 10 per cent. saline solution, and if filtered into distilled water myosin will appear in small flocculent masses. The three varieties form a series—globulin, myosin, fibrin. The first is readily soluble in a dilute acid or saline solution, the second is fairly soluble, the third soluble with great difficulty. Myosin may be regarded indeed as practically a more soluble fibrin, thrown down in masses instead of filaments. It no more exists in muscle than does fibrin in living blood, but springs into existence in a similar way on the death of the muscle. The coagulation of the dead muscle is called RIGOR MORTIS, and is more fully described under that head. *Vegetable fibrin* is described under GLUTEN-FIBRIN.

FIBROLITE. See BUCHOLZITE.

FIBROSPONGIÆ. See SPONGES.

FIBROUS TISSUE, the special material of tendons, &c. It is composed of bundles of white fibres with chains of cells among them. In freshly formed tendons of infants these cells are quadrangular and closely approach each other, but in mature tendon they are branched, somewhat fusiform, and separated, though still connected by a network of anastomosing processes. White fibrous tissue occurs in all tendons, in the dura mater, the fasciæ and ligaments, the sclerotic of the eyeball, &c. See also CONNECTIVE TISSUE.

FI'BRO-VAS'CULAR BUNDLES, in botany, are bundles of fibres and vessels running through the stem of plants. In woody plants they consist of two portions, the woody (or xylem) part and the bast (or phloëm) part. The xylem contains long wood cells, and may also contain wood parenchyma and vessels; the phloëm consists of fibres, generally thick-walled, very long, narrow, and flexible parenchymatous cells, and vessels with porous partitions, called sieve-tubes. In MONOCOTYLEDONS the fibro-vascular bundles run in an irregular manner through the stem, and do not increase in size. In DICOTYLEDONS and GYMNOSPERMS the bundles are arranged in a ring. The xylem, which lies towards the centre, is separated from the phloëm by cells capable of division, the CAMBIUM. At the beginning of the second year the cells of the fundamental tissue lying at the same distance from the centre as the cambium undergo rapid division, and form xylem on the inside and phloëm on the outside. This, the cambium layer, produces a complete ring of wood and bast every year, so that after the first year the bundles are no longer separate.

FIB'ULA. The fibula is a long and slender bone swelling out at the ends, by both of which it is firmly attached to the outer side of the *tibia*, or main bone of the leg below the knee. The lower extremity forms the projection of the outer ankle: it is received into a deep longitudinal groove at the side of the tibia, to which it is connected by a ligamentous union, and is firmly knit to the foot by strong bands of ligament, which spread like the sticks of a fan from the tip of the ankle to the bones of the heel and instep. Nine muscles are attached to the fibula. The *biceps cruris* bends the leg back towards the thigh; three on the fore part raise and extend the toes; the remaining five unite in raising the heel, and press the toes and the ball of the foot against the ground, at the same time turning the sole outwards by lifting its external border. The muscles chiefly concerned in the last-mentioned action are the *peroneus longus* and *brevis;* their tendons pass behind the ankle, lying in a groove of the fibula, which acts as a fixed pulley to change the line of their traction, and are inserted into two bones on the outer and inner edge of the sole near the base of the toes. They are very powerful muscles, and, when they act with sudden and spasmodic force, in consequence of the foot coming unexpectedly to the ground, are capable of breaking the fibula above the ankle by pressing the foot against its projecting end. This accident happens not unfrequently from the foot slipping unawares over the edge of a curb-stone. From the name of the eminent surgeon who first delineated and described this injury, it is called Pott's Fracture. The fibula derives its name from its fancied resemblance to the brooch-pin (*fibula*) of the ancient Romans.

FICH'TE, JOHANN GOTTLIEB, was born in Upper Lusatia in 1762. After receiving a school education he studied at the universities of Jena, Leipzig, and Wittemberg. He afterwards became acquainted with Kant and Pestalozzi, and in 1792 attracted general attention by his "Versuch einer Critik aller Offenbarung" (Attempt at a Critique of all Revelation), published at the instance of the generous Kant, to whom he had shown it, on account of which he was made professor of philosophy at Jena. Here he began to promulgate his system of philosophy, a transcendental idealism, starting from Kant as an origin, and (to English minds) losing itself in vague efforts towards the unattainable. This system is embodied in his "Wissenschaftslehre" (Doctrine of Science). A treatise "On Faith and Providence" which he wrote at Jena having brought upon him the ridiculous suspicion of irreligion he retired to Prussia, and after living for some time at Berlin removed to Erlangen, where he was appointed professor of philosophy, with leave to visit Prussia in the winter time. In 1810 the King of Prussia, a great admirer of the patriotic and eloquent addresses with which Fichte had encouraged his countrymen during the war, took advantage of the interval of peace to found the University of Berlin, and Fichte drew up its plan and statutes. By the unanimous vote of his colleagues he was elected the first rector. Here he attracted crowds of students, and here in 1813 that memorable scene occurred when the teacher, interrupted by the roll of drums in his course on Duty, as he was pointing out the duty to one's country when in danger, threw down his book and cried out, "This course of lectures will be suspended till the end of the campaign. We will resume them in a free country, or die in the attempt to recover her freedom." So saying he descended into the street and joined the ranks of a departing company of volunteers. Among the distinguished pupils who followed him was Froebel.

The character of Fichte has always been held in high esteem. His "Discourses to the German People" during the French invasion are justly valued, and he is said to have died, as he always lived, for a good cause. When the war broke out again in the year 1813 he urged his wife to visit the sick in the military hospital of Berlin, in consequence of which she caught a fever, from which she recovered, but communicated it fatally to her husband. Fichte died at Berlin in 1814, leaving a son, Immanuel Hermann, also one of the distinguished philosophers of Germany.

To analyse Fichte's system would be to inflict a needless weariness upon an ordinary reader; his main points and those of Schelling were absorbed and enlarged upon by HEGEL, and in the article upon that philosopher the attempt is made to convey an idea of the curious metaphysics of this modern German group of post-Kantian thinkers. The main characteristics due to Fichte himself are the contention that the ego posits the non-ego, that object is a mere creation of subject, a wild extension of our own Berkeley's idealism; and the doctrine of the triple nature of fundamental thought, as thesis, antithesis, and synthesis. The ego posits the non-ego—that is, consciousness of self implies a consciousness of something outside self (but yet, says Fichte, this *outside something* is a mere creation of the self)—and the non-ego by antithesis renders necessary the ego; but here comes in the synthesis, for by positing the non-ego the ego has posited *itself* as a contradictory to the non-ego. This is certainly the basis of Hegel's maxim, that being and not-being are the same, a theory at least as old in its fundamentals as HERACLEITUS. (Indeed, what did *not* the Greeks originate in art or in philosophy?)

But another thought of Fichte's, alluded to in the article AGES OF THE WORLD, is worthy of mention here, especially as it is more luminous than the former. It is his teaching of history as a combat of instinct and reason, and may fairly be assumed to be at least one factor in the far more deep and true teaching of the Comtist positive-philosophy on this point. See COMTE.

Fichte says that at first reason appears only in the cultured few; their mission is to raise the masses towards themselves, so reason ever grows and instinct diminishes. He divides this progress into five ages. I. Instinct predominant, primitive age. II. Authority predominant, force claiming obedience that order may be obtained. III. Reason attacks this authority: scepticism in intellect, license in morals, are the unhappy concomitants of this dawn of reason. IV. Reason becomes conscious of her mission: science develops, truth is discovered and welcome, efforts towards perfection are made. V. This science, these discoveries, this truth are at last applied, and humanity fashions itself after the dictates of reason alone.

FICHT'ELGEBIRGE, a mountain mass in Germany, situated between 50° and 50° 15′ N. lat., 11° 45′ and 12° E. lon. Its greatest length from N.E. to S.W., between the towns of Asch and Baireuth, does not exceed 35 miles,

and its average width is about 28 miles. It covers about 900 square miles. The whole mass is furrowed by narrow valleys and glens; its most elevated parts extend in plains, on which a few summits rise in the form of domes. These summits form a series arranged along the axis of the mass. Those that attain the greatest elevation are the Kösseine, the Ochsenkopf, and the Schneeberg, which rise respectively to 3024, 3340, and 3490 feet above the sea-level. The base on which the whole mass rests is about 1700 feet above the sea-level towards the south and west, and towards the east and north about 1800 feet. The Fichtelgebirge is the centre on which three extensive mountain ranges unite, and from which they may be considered to issue. These are the Erzgebirge, which begins near Asch and runs off in an E.N.E. direction, dividing Saxony from Bohemia; the Frankenwald (forest of Franconia), called further on the Thüringerwald (or forest of Thuringia), and of which the Hartz itself may be considered as the most northern branch, springs off from the north-western extremity; and the Böhmerwald (or forest of Bohemia), which runs off in a south-western direction. In consequence of this disposition of the mountain ranges, the waters which issue from the Fichtelgebirge run off to the four cardinal points. The nucleus of the mass is composed of granite, gneiss, and mica-slate; but on the north-western side it is surrounded by extensive beds of clay-slate and graywacke. It contains extensive iron-mines. Copper ore occurs frequently, but always in small quantities. Alum, serpentine, coal, garnets, tourmaline, &c., are also found.

FICOI'DEÆ or **MESEMBRYANTHEM'EÆ** is an order of plants included, with Cacteæ, among the Ficoidales, a cohort of the POLYPETALÆ. [See BOTANY.] The Ficoideæ are generally fleshy herbs or shrubs, with entire leaves and often showy flowers. The succulent leaves of the Hottentot's fig (*Mesembryanthemum edule*) are eaten at the Cape. The leaves of another species (*Mesembryanthemum emarcidum*) have a narcotic property when they are bruised and fermented; the Hottentots chew them like tobacco. Many yield soda; *Mesembryanthemum crystallinum* (the ice plant) is used in Spain to furnish an alkali for glass-works. The juice of the ice plant is diuretic. *Tetragonia expansa* is the New Zealand spinach. There are 450 species found in tropical and subtropical regions, very many occurring at the Cape. The flowers are regular, and generally hermaphrodite. The calyx has four or five lobes, which are green, herbaceous, and persistent. The petals in Mesembryanthemum are numerous and coloured; in the rest they are wanting, or are small and white. The stamens are usually perigynous, and numerous or few. The ovary is superior, sometimes inferior; generally with several cells, but these vary in number down to one only. There are several distinct stigmas. The ovules are solitary in cells and basilar, or several and attached at the inner angle. The fruit is usually a capsule, and is inclosed in the persistent calyx. The seeds are numerous, rarely definite, or even solitary. The embryo is more or less curved, surrounding the albumen.

FICTIONS, in law, have been somewhat quaintly defined to be "those things that have no real essence in their own body, but are so acknowledged and accepted in law for some especial purpose." These especial purposes are various. The law, it is said—by which we must understand those who for the time are the interpreters of it—shall never make any fiction but for necessity, and in avoidance of a mischief. This is as much as to say that those who interpret the law will, in order to avoid a special hardship, or remove some unexpected difficulty not provided for by the law, resort to a fiction; that is, they will imagine something to be which is not. It is said that such fictions have always a good end in view; that is, an end considered good by those who make or maintain the fictions. It was wisely said that fictions of law must not be of a thing impossible; but the reason is rather curious, "for the law imitates nature." If we object to the soundness of the reason in the instance last mentioned, we cannot but approve of the following rule as to fictions—that a man could never be subject to the penalty of a statute by a fiction of law. It was by means of fictions that the original limited jurisdiction of the Courts of Queen's Bench and Exchequer were extended to ordinary suits. In the latter every plaintiff assumed himself debtor to the crown, and could not pay his debt till the defendant had satisfied his demand; in the former it was assumed that the defendant had been arrested for a breach of the peace on a writ called a *latitat*, and so brought within the jurisdiction of the court. Blackstone mentions a case in which a contract at sea was feigned to be made at the royal exchange or other inland place, in order to draw the cognizance of the suit from the courts of Admiralty to those of Westminster Hall. But all this was abolished by statute 2 Will. IV. c. 39, and the High Court has now a direct and proper jurisdiction.

Fictions in law, though often ridiculous enough, have generally had their origin in some defect in the existing laws or course of procedure, and have pointed out in what respects the judges or interpreters of law, and, as we may suppose, general opinion also, under the influence of which judges must to some extent be, have felt that change was necessary. Many fictions, so far from being injurious, have often been beneficial; but their existence supposes a defect which it is the business of legislation to remedy.

In addition to the above there are some fictions designed to prevent the appearance of divergence of law from ethical justice; such is the assumption that no subject is ignorant of the laws under which he is ruled.

The law of Scotland has rarely resorted to fictions. Their aid was seldom necessary, because the tribunals, following the example of the ancient French courts, considered themselves warranted in applying the appropriate remedy wherever a wrong could be shown to exist, and because the same judicatures administered both law and equity. Some legal fictions may, however, be instanced. An heir is held to be the same person with his ancestor to the effect of making him liable for the ancestor's debts; and imprisonment for debt proceeded on the assumption that the debtor was a rebel, who refused to pay the debt in contempt of the order of his sovereign to do so.

FI'CUS. See FIG.

FIDDLE is the native English name for the chief of stringed instruments. It has given way in our times to the Italian variety of the same word, VIOLIN. The Old English *fidele* or *fithele* is the same word as the Old French *vielle* and the Italian *viola*. *Violino* is merely a small viola. It seems regrettable that the true English word is by so many (from sheer ignorance) thought to be a vulgarism. The ultimate derivation is from *vitula*, the Low Latin name of the fiddle, and the pure Latin name of a calf; and the connection between the two seems to arise from the music and the meat alike contributing to a merry-making. *Vitulari* was to hold a feast.

FIDEICOMMIS'SUM, in the Roman law, was something given by will or codicil, not directly to the person beneficially interested in it, but to some other person, with a request that he will transfer it to the party for whom it was intended. The person thus intrusted was called *hæres fiduciarius*, and the person for whom it was intended *hæres fideicommissarius*. It was necessary that an heir (*hæres*, in the Roman sense) should be named, or no property could be transmitted to the fideicommissarius. (Gaius, ii. 248, &c.) Originally it entirely depended on the good faith of the trustee (fiduciarius) whether he performed the will of the testator or not; but in the time of Augustus the rights of the fideicommissarius were declared legal, and the consuls had jurisdiction in these

matters. Afterwards prætors were expressly appointed, under the name of Prætores fideicommissarii, to take cognizance of such trusts, but the consuls still retained their jurisdiction also. In the provinces the governors (præsides) took cognizance of fideicommissa. (Ulpian, "Frag." 25, 12.) Fideicommissa, or trusts, of specific things, became gradually assimilated as to their qualities and incidents to legacies, and were even employed for the purpose of establishing a particular order of succession, thus affording the earliest illustration of entails.

FIEF. See Feudal System.

FIELD, in heraldry, is the surface of the shield, the charges being represented upon the evenly-coloured field. The colour of the field is of course an important distinction in coats of arms.

FIELD, JOHN (1782–1837), a musical composer of great charm, is often known as "Russian Field," from the length of his stay in Russia. He died at Moscow. Field was the son of a London musician, who made him practise so hard at the pianoforte that he ran away from home, and only returned from sheer want. He became salesman in Clementi's pianoforte shop, and received lessons from Clementi. Although he speedily became a most accomplished performer, Clementi kept him as a salesman and took him in that capacity to Russia; where, however, Field's playing of his own compositions so charmed the lovers of music that he was induced to stay, 1804. He never left Russia, except on flying visits to London and other great cities. It is to be feared that he became habitually intemperate towards the close of his life. He lay at Naples in the public hospital in 1833 for many months, quite neglected, destitute, and very ill; a Russian family found him there and took him back to Russia, but he never recovered health or spirits. Field's exquisitely charming Nocturnes were far more the basis of Chopin's masterpieces (especially as Field played them, with added embellishments of his own) than lovers of Chopin at all times like to acknowledge. They are, if possible, more admired to-day than ever before.

FIELD'FARE (*Turdus pilaris*) is a European bird of the Thrush family. This bird is of a grayish colour, the feathers being tipped with a dark spot: the throat and breast are of a light brown colour, the tail nearly black, and the under parts white. It arrives in Britain from the north of Europe in October, and remains until the following spring. Besides England it visits in the winter the rest of Europe and Western Asia; its extreme southern limit is Northern Africa. It breeds in the forests of Norway, Sweden, and Russia, and occasionally in some parts of Germany. The fieldfare roosts in trees, leaving for the fields at early dawn in small flocks or coveys, its flight being easy but not rapid, and its movements graceful. Its food consists of hawthorn and other berries, worms, insects, seeds, and grains. The fieldfare is the most gregarious of all thrushes, a large number building their nests in society, usually in fir and spruce trees. It is easily tamed, and sings well in captivity.

FIELDING, ANTONY VANDYKE COPLEY, usually called Copley Fielding (1787–1855), was a landscape painter in water colours of considerable merit, especially successful in delineating Sussex scenery, both the undulating South Downs and the Channel Sea. He rose to be president of the Water-Colour Society. He died at Worthing, admittedly at the head of his branch of his profession at the time of his death, and as much beloved as admired.

FIELDING, HENRY, born 22nd April, 1707, was the son of General Edmund Fielding, a descendant of the earls of Denbigh. Being designed for the bar, he was removed from Eton to the University of Leyden, but soon returned to London, plunged into the dissipation of the metropolis, and as a means of support, between 1727 and 1736, produced eighteen comedies and farces for the stage, few of which are now known or read.

About the year 1736 Fielding married, and in three years afterwards entered himself at the Temple, to prepare for the bar. At the usual time he was called; but gout, the consequence of his early dissipation, rendered it impossible for him to practise with regularity sufficient to insure success. Some time afterwards the publication of Richardson's novel of "Pamela" gave him an opportunity of entering upon an employment which he found preferable to the study of law. He wrote as a satire on "Pamela" the history of her brother, "Joseph Andrews;" but the author visibly warms with his subject, and draws characters which perhaps none but he could have drawn in any case, and not even he himself had he kept his primary object distinctly in view.

After the publication of "Joseph Andrews," in 1742, Fielding wrote his play, "The Wedding Day," and a tract called "The Journey from this World to the Next," which was followed by "Jonathan Wild." The rebellion of 1745 induced Fielding to take the direction of a paper called the *True Patriot*, directed against the Jacobite party, and in support of the Hanoverian succession. This, with other publications of the same kind, at last obtained him a small pension and the place of justice of the peace for Middlesex and Westminster, which he is said to have owed to the influence of Lord Lyttelton.

Amidst the laborious duties of a magistrate and pamphleteer, for Fielding was both at once, he contrived to produce "Tom Jones," a novel which for graphic description, originality of characters, and interest of the tale, has been and ever will be held in the very highest admiration. The publication of "Tom Jones" was followed by some works on the Poor Laws. He also wrote a charge to the grand jury of Middlesex and some law tracts.

"Amelia" was Fielding's last important work. It was published in 1751, soon after which he was attacked by dropsy, jaundice, and asthma, and, when all remedies had been tried in vain, a change of climate was proposed by his physicians. He left England for Lisbon, 26th June, 1754, and died there in October of the same year, aged forty-seven, leaving a widow and four children.

Fielding has been styled, with perfect justice, the father of the English novel. Sir Walter Scott observes that Richardson by no means succeeded in escaping from the trammels of the French romance. But in Fielding's works we find the most perfect delineations of individual character—Squire Western, Tom Jones himself, Allworthy, and perhaps, above all, Amelia and Mr. Abraham Adams, are portraits which proclaim their own truth. Unhappily his works are all disfigured by occasional coarseness.

FIELD-MARSHAL, a military dignity conferred on such commanders of armies as are distinguished by their high personal rank or superior talents.

The maréchaux de camp, in the old French service, were charged with the duty of arranging the encampment and providing subsistence for the troops. From the title borne by this class of general officers is derived that of field-marshal in the German armies, and we have adopted the title from the German. When unemployed a field-marshal in the English army has no higher pay than any other general; but if commander of an army he receives £16 8*s.* 6*d.* a day for staff pay, while a general has but £9 9*s.* 6*d.* The equivalent rank in the navy is that of Admiral of the Fleet.

FIELD-OFFICER, an officer in the army above the rank of captain, as a major or colonel, competent to command a whole battalion.

FI'ERI FA'CIAS or **FI. FA.** See Execution on Civil Process.

FIESOLE, the ancient *Fæsulæ*, a considerable city of Etruria, now a small though celebrated village of Central

Italy in the province of Florence, on a precipitously steep hill commanding a fine view of the Val d'Arno, 4 miles N.E. of Florence. The population in 1881 was 13,888. The face of the hill is cut into a gradation of narrow terraces, inclosed in a trellis of vines, and faced with loose stone walls. It has a cathedral, a seminary, and numerous country houses belonging to the citizens of Florence. It is first noticed by Polybius in his account of the early wars between the Gauls and the Romans. It was the head-quarters of Catiline, who retired thither after the discovery of his conspiracy. Near it, in 405, was fought the last great battle gained by the Romans in Italy, in which Stilicho defeated Radagaisus and the Huns. In 1010 the Florentines dismantled and ruined Fiesole, and enlarged their own city with some of its materials; but the ruins of a few of its ancient buildings are still visible, particularly those of its Etruscan walls, and of an amphitheatre supposed to be of Roman origin.

In still later times the vicinity has gained fresh interest, for here, between the town and Florence, stood the monastery numbering among its brethren the celebrated painter Fra Angelico. Near its site is the villa where Walter Savage Landor lived several years, and the villa Mozzi, the favourite palace of Lorenzo the Magnificent.

FIFE, a very small flute, giving acute piercing sounds. It is an octave higher than the flute, and in compass comprises two octaves, from D on the fourth line of the treble clef to D above *in altissimo*. It is made in several keys, the nominal D being respectively F, B♭, and E♭. It is a great favourite in the English army and navy, and many bands are composed of these instruments and small side-drums. In the infantry there is a fifer to each company, and a fife-major to each battalion.

FIFESHIRE, a county of Scotland, is bounded S. by the Frith of Forth, E. by the North Sea, N. by the Frith of Tay, and W. by Clackmannan, Perth, and Kinross. The greatest length, N.E. to S.W., is 44 miles; the greatest breadth, N.W. to S.E., 18 miles. The area is 513 square miles, or 328,427 acres, of which more than four-fifths are arable and pasture land, and the remainder hills, moors, woods, &c. The population in 1881 was 171,931.

The county is one of the most pleasant and best cultivated in Scotland, and no other has a larger number of gentlemen's seats. The soil is of various kinds. In the most fertile districts it consists principally of a rich loam; in the poorer tracts it is mostly a wet clay, resting on a cold bed of till. A level tract of deep, rich, and very fertile loam extends from east to west along the whole southern side, varying in width from 3 miles to 1 mile from the shore of the Frith of Forth. There are in other parts very rich tracts of land, especially the valley of the Eden, which is sometimes called the Howe (hollow) of Fife and sometimes Strath Eden. The climate is dry, healthy, and mild on the Forth, but the valleys in the north are much exposed to the full sweep of the east and north-east gales.

Fifeshire is watered by numerous streams, of which the chief are the Eden and the Leven. The first rises in the Lomonds, and after a course of 20 miles falls into St. Andrews Bay. The latter issues from Loch Leven in Kinross, and has a course of about 14 miles, discharging into the Frith of Forth at the town of Leven. Fresh springs are found in almost every field. There are lakes or lochs at Leven, Fitty, and Lindores. The extensive water boundary gives the county many excellent ports and small harbours, from which steam communication is kept up with Edinburgh, Dundee, Perth, and other places. Most of the chief towns of the county are linked together by railways.

The county, in a geological point of view, is one of the most interesting in Scotland. It is rich in organic remains; coal and limestone also of the best description are found in abundance in almost every part of the county south of the Eden, but they are not found in the upper division, north of this river. The collieries are numerous, and some are very extensive and employ a large number of hands. Limestone quarries are numerous in various parts of the southern district. Ironstone is plentifully obtained in several parts of the coal-fields, especially near Dysart, and in the parish of Balgonie. Lead-mines have been worked in the Lomond Hills. Freestone, whinstone, and many of the primitive rocks are abundantly met with. There are beds of rich marl, brick-clay, and peat. Gems are sometimes picked up in the beds of the rivers.

There are a few patches of natural wood in Fife. The plantations are numerous, and the timber in them, which is mostly aged and valuable, consists of ash, elm, beech, fir of different kinds, limes, chestnut, sycamore, and oak. Gardens are numerous, but orchards are rare. Most of the indigenous and other animals of Britain, wild and tame, are found in this county. The farms are from 50 to 500 acres, and are generally let on a nineteen years' lease. They are for the most part very well managed, great improvements having been introduced during the present century, both in the farm and cottage buildings and in the system of farming. Lime is chiefly obtained for manuring purposes. The area under cultivation in 1886 was 250,000 acres, or about five-sixths of the whole county. The number of acres devoted to corn was 84,000; to green crops, 45,000; to clover and artificial grasses, 64,000; and 55,000 were permanent pasture.

The county has been long distinguished for the excellence of its breed of black cattle, large numbers of which are sent to England. The sheep are chiefly of the Cheviot breed. The number of cattle in the county in 1884 was 40,000, and of sheep 80,000.

Small breweries and distilleries for the manufacture of malt liquor and spirits; flour and pot-barley mills; salt, coal, tan, soap, and brick and tile works—are among the industrial establishments of the county. But the linen manufacture is by far the largest; it employs a great number of hands, who spin and weave flax into damasks, diapers, checks, ticks, coarse sheeting, and many other kinds of linen fabrics. Plaids and blankets are also made to some extent, and the iron manufacture has assumed somewhat considerable dimensions. There are fisheries of salmon, cod, turbot, haddock, &c., off the coasts.

Fifeshire contains thirteen royal and parliamentary burghs and sixty-three parishes. The county returns two members to Parliament, the St. Andrews district one, the Kirkcaldy district one, and Dunfermline and Inverkeithing are included in Stirling district, which returns one. The number of voters on the county register is 17,527. The chief town is Cupar.

History and Antiquities.—Prior to the eleventh century this district was either the property or wholly under the jurisdiction of the powerful thanes of Fife, who bore the family title of Macduff.

The county contains a great number of ancient edifices, once the dwellings of powerful nobles, but now either fallen or falling into decay. Some of these ruins are truly magnificent, and are striking monuments of the taste and opulence of the feudal and monkish ages. In the town of St. Andrews the remains of several superb structures are still to be seen. In Dunfermline, too, there are vestiges of some ancient buildings of great extent and magnificence. Near Newburgh are the venerable ruins of the abbey of Lindores. The large palace or castle of Falkland, a seat of the Macduffs, is particularly worthy of notice; the south front is yet entire, and partly inhabited. The cross of Mugdrum and the cross of Macduff on the Ochil Hills, the abbeys of Inchcolm and Balmerino, the priory of Pittenweem, the palace at Falkland, Beaton's Tower, near Monimail, the castles and towers of Rosythe, Loch Orr,

Scafield, Ravenscraig, Macduff, Craig Hall, Tarvet, Balgonie and Balwearie, are among the antiquarian remains of the county.

In this county have been found a large number of ancient remains, including vestiges of the prehistoric natives, the Caledonian and Pictish inhabitants, and of their Roman and Danish invaders, such as canoes, ancient military forts and mounds of encampment, groups of Druidical stones, cairns, tumuli, barrows, stone-coffins, Celtic sepulchral urns, spear and arrow heads of flint, swords and battle-axes of brass and bell-metal, crosses, fonts, beads, Roman and other coins, weapons, &c.

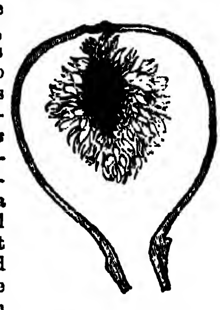
FIFTEENTH, in music, is the interval of the double octave. [See INTERVAL.] The fifteenth stop, in organs, is a range of pipes, tuned two octaves (*i.e.* the interval of a fifteenth) higher than the diapasons.

FIFTEENTHS, in the middle ages, was the name of a tax or tribute imposed upon the various towns of the whole country for the maintenance of the state. It was so called because it was the fifteenth part of what the town or city was anciently valued at.

FIFTH, in music. See INTERVAL.

FIFTH MONARCHY MEN, a sect of religionists whose distinguishing tenet was a belief in the near coming of a fifth universal monarchy, of which Jesus Christ was to be the head, while the saints, under his personal sovereignty, should possess the earth. They appeared in England about 1654; and in 1660, a few months after the Restoration, they broke out into a serious tumult in London under their leader Venner, in which many of them lost their lives, some being killed by the military, and others afterwards executed.

FIG (Ficus), a large genus of plants belonging to the URTICACEÆ, having the flowers, both male and female, mixed indiscriminately on the inside of a fleshy receptacle, which is so concave that its edges are drawn together into a narrow opening. This is illustrated by the common eatable fig, the receptacle of *Ficus Carica*, which, although resembling a fruit as simple as a gooseberry, is in fact a collection of a large number of minute unisexual flowers growing on a succulent base; at its apex will be found the narrow opening where the edges of the receptacle are drawn together, and when its interior is laid bare the flowers are seen closely packed over its surface, divided from each other by soft, colourless, bristle-like bracts or scales. What are called the seeds in the ripe fig are the pericarps, each of which contains a single seed.



Flower Receptacle of the Fig.

The number of species of Ficus is very considerable, perhaps as great as that of any arborescent genus. They are all either tropical or inhabitants of warm countries. Some are small plants creeping upon the surface of rocks and walls, or clinging to the trunks of trees like ivy; others are among the largest trees in the forest. All travellers in the woods of South America speak of the noble aspect of the fig-trees (meaning species of Ficus not of the cultivated sort), of their gigantic dimensions, and of the thick delightful shade cast by their leafy heads. They are specially remarkable for throwing out roots from their branches, which, after they have reached the ground and established themselves there, increase rapidly in diameter, produce other branches, and thus contribute to extend an individual over a considerable space of ground. The well-known BANYAN is an instance of this peculiar habit. The species abound in a milky juice containing caoutchouc.

Sycamore-fig Tree (*Ficus Sycomorus*).

Although the fruit of *Ficus Carica* and some others is eatable, yet the whole genus abounds in an acrid, highly dangerous principle, diffused among the milky secretion. This is perceptible even in the common fig, whose milk produces a burning sensation on the tongue and throat; but when the fruit of that species is ripe, the acridity is destroyed by the chemical elements entering into new combinations. In some species it is so concentrated that they are among the most virulent of poisons. *Ficus toxicaria*, a Sumatra species, derives its name from this circumstance, in which many more equally participate.

Ficus Sycomorus (the sycamore fig) is a large tree found in Egypt, where it is planted extensively by the roadside, near villages, and on the sea-coast, for the sake of the shelter of its very widely spreading branches. The Arabs call it Djummeiz. Forskühl states that its head is often 40 yards in diameter. The figs are sweet and delicate, and eaten by the Egyptians.

Ficus elastica (the Indian caoutchouc tree) is now a common tree in the hothouses of this country. It inhabits the mountains which bound the province of Silhet on the north, where it grows to the size of a European sycamore, and is called Kasmeer. It is chiefly found in the chasms of rocks and over the declivities of mountains, among decompósed rocks and vegetable matter. It produces when wounded a great abundance of milk, which yields about one-third of its weight of caoutchouc. Old trees yield a richer juice than young ones. The milk is extracted by incisions made across the bark down to the wood, at a distance of about a foot from each other all round the trunk or branch up to the top of the tree, and the higher the more abundant is the fluid.

Ficus religiosa (the Peepul tree) is a large tree common in every part of India, especially near houses, where it is planted for the sake of its extensive dark grateful shade. It is held in superstitious veneration by the Hindus, because their deity Vishnu is fabled to have been born under its branches. Silkworms prefer the leaves next to those of the mulberry.

Ficus Carica (the common fig) is a small tree with rough, lobed, deciduous leaves, naturally inhabiting the temperate parts of Asia, and now commonly cultivated in Europe for the sake of its fruits.

In the fertile islands of the Mediterranean, in Spain, Italy, and Greece, and even so far north as the south of France, the fruit is so well ripened as to form a valuable article of exportation in a dried state. The fruit is grown with some success even in the southern and milder parts of England, but it is seldom found in the northern parts or in Scotland, except under glass.

The most approved methods of propagating fig-trees are either by layers or cuttings; and the former method is generally preferred, because the plants at the end of the season are stronger and more fit to be planted out where they are intended to grow. Trees raised from layers generally come into bearing the second year. Grafting succeeds upon these trees as well as upon any other, but it is almost unnecessary and seldom practised. Before the trees are planted the ground should be well drained, and made from 2½ to 3 feet deep, with a mixture of good friable loam and decayed dung. Miller remarks that "fig-trees bear the greatest quantity of well-flavoured fruit when grown upon chalky land where there has been a foot or more of a gentle loamy soil on the top."

To protect the plants in winter in this country the common practice is to stick yews, spruce-fir branches, or fern leaves among the branches of the fig upon the wall. Where anything can be used for protection which can conveniently be removed in fine mild weather, it will be found of greater utility than having the branches covered up from the commencement of winter until the end of spring.

The fig-tree is very apt to throw off its fruit before it ripens, and various methods have been suggested to prevent this. In the Levant, to insure a crop, the process of caprification is resorted to. Caprification has always been a matter of such interest, from a practical as well as a botanical point of view, that it may be well briefly to refer to what is known on the subject, and especially to the latest investigations by Count Solms-Laubach, professor of botany at Göttingen (*Die Herkunft*, *Domestication*, *und Verbreitung des gewönlichen Feigenbaums*, 1882). The ancients distinguished two kinds of fig-trees—(1), a cultivated variety of eatable figs, *sukon* of the Greeks, *ficus* of the Romans, our fig; (2), an uneatable wild fig, cultivated for a special purpose, the *erineos* of the Greeks, *caprificus* of the Romans, *profico* of the Neapolitans, our caprifig.

Branch of Sycamore Figs.

Branch of the Fig-tree (*Ficus Carica*).

Linnæus considered the fig and caprifig to be respectively the female and male of polygamously diœcious species, and this opinion is also held by Fritz Müller in an article in *Kosmos*, 1882.

In the caprifig the tissue of the receptacle remains hard and milky, even when the fruit is ripe, or it softens imperfectly, and dries up without any formation of sugar. It

produces three crops of fruit in the year—(1), the fornites, which develop in August, and ripen in September (the *mammoni* of the Neapolitans); (2), the cratitives, which appear while the mammoni are still hanging, remain through the winter, and ripen in May (the *mamme* of the Neapolitans); (3) the orni, which shoot forth in May (*profichi*).

The fig bears two crops, but usually only the summer crop ripens. The receptacles are without male flowers, or have in exceptional cases a few deformed males. Still there are varieties which have both male and female flowers.

In the caprifig there are female as well as male, the latter occupying a small space just within the mouth of the receptacle. When the stigmas are mature, the male flowers are still in a very early stage of their development, and very rarely is any seed produced. The male flowers of the caprifig fertilize the female flowers of the fig. This operation is known as caprification, and the way in which it is effected by means of insects is one of the most complicated and perfect instances of mutual adaptation that natural selection has attained in this direction.

When the profichi are ripe, in June, small gnat-like insects (*Blastophaga grossorum*) pass out through the narrow opening at the top of the profichi, and become dusted with pollen as they escape. This insect undergoes its transformations in the three crops of fruit produced by the caprifig. The females enter the profichi, and lay an egg in the single ovule of every ovary. A gall-formation is produced, and the ovule develops into an imperfect seed. Branches of the caprifig are placed on fig-trees, or a few trees of the caprifig are planted in the fig orchards. The insects pass from the caprifigs to the figs and fertilize them, but are unable to deposit their eggs within the integuments of the ovule. When the seed is sown some of the plants raised are the pure caprifig, while others are a variety of fig.

The quantity of figs annually imported into the United Kingdom varies from 75,000 to 100,000 cwts., more than three-fourths of the whole being received from Asiatic Turkey.

FIG'ARO, a celebrated dramatic creation introduced by Beaumarchais into his comedies "Le Barbier de Seville," "Le Mariage de Figaro," and "La Mère Coupable," which at once became popular as an embodiment of amusing knavery. The character has formed the subject of operas by Mozart and Rossini, and the word has been used as a title by a popular Parisian journal founded in 1854, and which still holds a leading position. There is also a London *Figaro*. The name is said to be derived from an old Italian and Spanish word meaning a wigmaker.

FIGHTING FISH. See Betta.

FIG-SHELL (Pyrula) is a genus of molluscs belonging to the class Gasteropoda and family Muricidæ. The shell is spiral or pear-shaped (hence the generic name), the columella smooth, the spire short, and the outer lip generally thin. The canal of the shell is long and straight. The operculum is absent in the typical species; when present it is of an ovate figure, small in size and acute or claw-shaped. The head is elongated and conical, and bears very small tentacles. The foot is simple in front. Thirty-nine species of this genus have been described. Their distribution is extensive and chiefly subtropical—from China, Australia, Ceylon, Western America, and the West Indies. Fossil species occur in Europe. Many species are of considerable size, as *Pyrula patula*, which lives on the mud-banks of Panama, and is eaten.

FIGUE'RAS, a town of Spain, near the N.E. extremity of the kingdom, on the road between Perpignan and Barcelona, 71 miles N.N.E. of the latter. It is a long straggling town, situated in the middle of a plain on which an abundance of olive-trees and rice are grown. It has a parish church, several convents, and an hospital. Population, 8000. About 3 furlongs W.N.W. of the town is the citadel or castle of San Fernando, constructed at an immense cost about the middle of the last century, and reckoned one of the finest fortresses in Europe. Its form is an irregular pentagon; the walls are of freestone, and very thick; the moats deep and wide; its ramparts, magazines, stables, cellars, barracks, and hospital are defended by a casemate; and the firm bare rock on which it is built has been turned to so great advantage that it is said trenches can scarcely be opened on any side, the ground being everywhere stony. It will serve as an entrenched camp for from 16,000 to 17,000 men. It has, however, been several times captured—in fact so often that the saying arose that in war time it belongs to the French and in peace to the Spaniards.

FIGURE, in geometry, a finite space which has a boundary in every direction. The figure of a space is the notion we receive from observing its boundary.

Figure, in music, is a pattern of accompaniment, as for instance a variety of grouping into which the notes of the accompanying chords are thrown to support the melody; or the melody itself may be made up of repetitions of a figure.

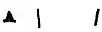
In a broader sense a figure is any definitely marked group of notes, whether repeated or not repeated, and every melody is in this sense made up of phraselets or figures. The meaning first given, however, is the usual musical meaning of figure. An excellent example of a most striking figure carried through an entire accompaniment would be the pizzicato accompaniment to the serenade in "Don Giovanni."

FIGURE OF THE EARTH. The first conception we know as having been held of the figure of the earth was that of Thales the Greek philosopher (born B.C. 636). He held that it was a flat plane floating in water (the ocean). Anaxagoras (born B.C. 699), the friend of Pericles, who first taught in Greece that lunar eclipses were caused by the shadow of the earth falling on the moon, yet, strangely enough, quite failed to perceive the significance of the invariably circular form of the shadow. It is not till Aristotle's time (born B.C. 360) that we find the true doctrine held. Aristotle was the first to give proofs of it. He enumerated the two following as the chief proofs:—In travelling south the pole lowers in the heavens, and new stars appear southwards never before seen; the shadow of the earth on the moon is always circular, although both sun and moon are moving, and hence many different outlines of the earth must have been brought into play. To these we commonly add the fact of ships being seen "hull down" at sea, as if they had gone over a hill; and the fact that we can travel round the globe by continuing in any given direction.

The Bedford Level test (agreed upon as suitable to decide a wager of £1000) was a singularly conclusive one. There are two bridges 6 miles apart there, the canal flowing level beneath them. A telescope was set up on one bridge and a disc on the other, each 10 feet above the water; and midway in a line between them a pole carrying another disc was fixed in the bed of the canal, so that the disc was also 10 feet above the water. Now, if the surface of the water be flat, evidently the middle disc would exactly cover the further one; but if the earth be round, and therefore also the water round, the middle disc would be (in the usual earth-measurement) apparently 6 feet *above* the further disc. This proved on trial to be actually the case, so that the £1000 was paid over. The loser ever after maintained that the fact was not proved, but he stood alone in his opinion.

Mr. R. A. Proctor has added a number of further proofs of the earth's rotundity (*Knowledge*, vol. iv., 1883), from among which we select the following:—Observe a distant shore across a stretch of water, and you will see the edge or horizon of the water quite sharp, while the shore beyond is misty from distance. If examined by a

telescope the horizon of the water will be found to require a very much nearer focus than that of the shore beyond, plainly showing that you are looking at the summit of a hill of water which is far nearer to you than the invisible water laving the foot of the cliff miles away. Or observe through a telescope the top yards of a very distant ship, all the rest of which is concealed behind the hill of water, and as the ship on which you stand pitches slightly, the yards of the distant ship will be seen to rise and fall above the watery horizon as if pitching in a startling manner. Of course any real pitching of that ship would be reduced to a very slight motion by the great distance. Or finally, when travelling in a tram-car, or a railway carriage on the continental model, along a very long stretch of straight railway, look from the end platform at the metals, and then by stooping, bring the horizon nearer. The metals, which at first converged as at A, will now rather appear as at B.

A  B

You can see further over the "hill," in fact, when you stand upright. If the earth were not round it is manifest that this result would be impossible. It is assumed that the railway is level in this observation.

But these considerations only show that the earth is round. It is clearly improbable that the earth should be a true sphere, because of its rotation, since the enormous centrifugal force exerted on the equator could not be without an effect. Accordingly Newton, assuming for the sake of argument that the earth had a fluidity homogeneous throughout, calculated that in those circumstances the polar diameter would be to the equator as 229 to 230; that the equator would bulge as 1 in 230.

In the article BASE LINE it was shown how actual measurements of the earth are taken; and by such actual measures the following results, among others, have been gained. The length of a degree in the following places varies in English feet as under:—

		Feet.
India at lat.	12°, ...	362,956
India "	16°, ...	363,044
France "	45°, ...	364,572
England "	52°, ...	364,951
Russia "	56°, ...	365,291
Sweden "	66°, ...	365,744

So that the nearer the equator we get the shorter is the degree of latitude, which is according to the theory arrived at above, and indicates a quicker curve or outward bulge at that part.

Calculations founded on a large number of such data, together with a consideration of the phenomena of PRECESSION and of NUTATION, lead the best observers to set down the earth's diameter as under—

	Feet.
Mean equatorial diameter, ...	41,848,380
Mean polar diameter, ...	41,708,710

But further, the equatorial diameter itself is not a circle. The earth is not only orange-shaped, flattened at the poles, but it is like a squeezed orange. Two equatorial diameters were shown to exist by Captain Clark (*Royal Society's Transactions*, 1880):—

	Feet.
Equatorial diameter I., ...	41,852,864
Equatorial diameter II., ...	41,843,096

That is to say, the equatorial diameter piercing the earth 14° 23′ east of Greenwich (and emerging on the opposite side, of course, at 165° 37′ west of Greenwich) is 2 miles longer than that at right angles to it.

FIGURED BASS, sometimes called by old-fashioned people *Thorough Bass*, is a kind of musical shorthand, expressing a chord very simply by the figure of its interval or intervals from the bass.

The common chord (or the note, its Third and its Fifth) is usually left unfigured, or if absolutely necessary to figure it, it bears the figures $\begin{smallmatrix}5\\3\end{smallmatrix}$; or 5 or 3 if only one of the intervals calls for mention. The first inversion of this, $\begin{smallmatrix}6\\3\end{smallmatrix}$, is usually figured simply 6. The second inversion, $\begin{smallmatrix}6\\4\end{smallmatrix}$, is always so figured.

Sevenths (the note, its Third, Fifth, and Seventh) are figured simply 7, unless it is necessary to call attention to the 5 or to the 3. The inversions of the Seventh are figured $\begin{smallmatrix}6\\5\end{smallmatrix}$, $\begin{smallmatrix}4\\3\end{smallmatrix}$, and $\begin{smallmatrix}4\\2\end{smallmatrix}$ respectively, the 3 being omitted from the first usually, and the 6 from the two last.

Ninths are figured $\begin{smallmatrix}9\\7\end{smallmatrix}$ to distinguish them from suspended ninths (which are figured 9 8); and Elevenths and Thirteenths usually have the exact intervals of the chord figured, as these are so variable.

A line drawn over two bass notes means that the chord indicated for the first is to be continued against the second. The sign ♯ or ♭ standing by itself over a bass note applies to the Third of the chord; and any accidental may be used before a figure, changing the corresponding note just as it would do if used in the stave. Or a line drawn through the figure if slanting upwards indicates that that note is to be sharpened, and if slanting downwards that it is to be flattened. Two sets of figures over one bass note indicate two chords as being desired to that note. Exercises in harmony (chord-writing) are always given in figured bass. The following example is from Professor Macfarren's "Harmony":—

It might be thus answered:—

In this way, with a line of bass accompanying a melody, a composer may rapidly sketch out whole movements; and much of Handel's work, and work of his time, exists only in this form. The exact FIGURE of the accompaniment and position of the notes in the chords was left to the skill and fancy of the accompanist.

Dr. Day suggested a great improvement in figuring. This consists in referring the chord always to its root position, but indicating its inversion by the letters A B C, &c., A being the root position, B the first inversion, &c. Without going into exact detail, the principle of Day's alteration might be indicated by thus altering the figuring of the above—

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 98             9     7
 7.             7     ♯
A B    A B A    ♯  C  A
                A
```

The object of Dr. Day was to render it absolutely clear what chord was desired, which, under the usual method, is not always the case. For example, the first inversion of a

Ninth and the root position of a Seventh would alike bear the figure 7, and the student would possibly be uncertain as to which chord he was required to write. Dr. Day, however, would figure the one $\frac{9}{B}$ and the other $\frac{7}{A}$, avoiding all possible confusion.

FIGURES, in the sense of digits, is asserted by Dr. Brewer ("Dictionary of Phrase and Fable") to be nothing more than a translation of the Latin, *fingers* having been corrupted to *figgers*, and hence confused with *figures* or forms (Latin *figura*). However this may be, certainly the Latin word *digitus*, used for the symbols of number, is simply the Latin for finger. Its origin is manifest. One finger held up, I, stood for *one*, two fingers, II, made two, so III for three, and IIII for four. The hand was of course five, and as the thumb and the closed fingers made two diverging lines like the Latin letter V, this symbol represented the digit five. Then one hand and one over, VI, gave six; one hand and two over, VII, seven; so also VIII, eight, and VIIII, nine. Then two "hands" placed with vertices together gave twice-five, X, ten. Finally all these finger-signs or digits being firmly grasped, it occurred to some one to reverse some of the arrangements. Thus, since VI meant I added to V, why not, by placing the I on the other side of the V, indicate that it was to be taken from V? Thus we get IV for IIII, and IX for VIIII, and the confusion of so many strokes is obviated. But the device is very clumsy. It is also used as XL for forty (ten less than L, fifty), and XC for ninety (ten less than C, a hundred). The worst arrangement, however, is LIX, LIV, &c., for fifty-nine, fifty-four, for these would logically mean fifty and one and ten, *i.e.* sixty-one, &c.

FI'JI, FEEJEE, or **VITI ISLANDS,** the most recently acquired colonial possession of Great Britain, are a group in the South Pacific Ocean, lying between lat. 15° 30′ and 20° 30′ S. and lon. 177° E. and 178° W., and extending over an ocean area of about 40,000 square miles. They were discovered in 1646 by Tasman, the Dutch navigator. There are together 300 islands and islets, about eighty of which are inhabited, with a population which, previous to the ravages of measles in 1875, numbered 150,000. The population in 1881 was 124,002. Two of the islands only are of considerable size, namely, Viti Levu (Great Fiji), and Vanua Levu (Great Land). The former measures 90 miles from E. to W. and 50 from N. to S., and has 4479 square miles. It contains the capital, Suva. The latter is 100 miles long, with an average breadth of 25 miles, and an area of 2486 square miles. The highest mountains are on Viti Levu, and reach an elevation of 4000 to 5000 feet. On Vanua Levu are five hot springs, the temperature of which is from 200° to 210°. The natives boil their yams in them in fifteen minutes. All the islands are girt with coral reefs, and are therefore rather dangerous of access, but within these there are excellent harbours. The greater part of the surface is undulating or hilly, and the soil, a deep yellow loam well watered, is exceedingly fertile. Scarcely an acre is to be met with that might not be cultivated or converted into pasture. The chief vegetable products are the bread-fruit tree, the banana, plantain, and cocoa-nut, of each of which there are several varieties. The tea-plant, caraway, nutmeg, sugar-cane, arrow-root, capsicum, sarsaparilla, and pine-apple flourish. The principal articles cultivated are sea-island cotton, coffee, sugar, and tobacco, and of each of these there is a considerable and increasing production, only limited by the want of labour. The country is well watered by rivers and streams.

The geological formation shows that the islands have been subjected at various times to volcanic action, and earthquakes are occasionally felt. Malachite, antimony, graphite, and a little gold and iron sand are found. The species of mammalia are few, and the land birds consist of forty-one species—seventeen peculiar to the islands.

The country is fairly healthy, intermittent fevers, the scourge of so many tropical regions, being rare, and zymotic diseases unknown. An epidemic of measles, however, broke out in 1875, during which upwards of 40,000 Fijian natives died. The disease is supposed to have been carried to the islands by a vessel from Sydney. Fiji is a place where a European can work, if he is not afraid of using himself up; but the climate is subtropical, and the resemblance to the Mauritius much greater than to New Zealand. The mean temperature during five years was 79·1°, the maximum being 97·7°, and the minimum 58·5°; while the rainfall in a recent year was 251·57 inches, or eight times the average London rainfall. Rain falls throughout the year, being most abundant from October to April.

The natives consist of two races: the almost black Papuan or Melanesian stock, fierce, finely-grown, acute, and not destitute of arts, which spreads through Sumatra, Borneo, New Guinea, New Hebrides, and New Zealand. The other race is the gentler, brown-skinned Polynesian. To these must be added, in some numbers, hybridized descendants of the two.

It has been estimated that 103,000 out of the 124,002 persons representing the entire population of the colony, are Wesleyans. Members of the Church of England number 1900 only, and Roman Catholics 9000. The "unknown and heathen" portion of the population are reckoned at only 11,000. The Wesleyan missionaries are said to have 1200 chapels and other places of worship; the Roman Catholic, 60. There is no ecclesiastical establishment, the churches being supported entirely by voluntary contributions.

Fiji was notorious in former times for the cannibalism of its inhabitants. Not only prisoners of war and crews of wrecked vessels, but persons of the same tribe and village, were clubbed and eaten. Up to the year 1854 some of the native chiefs kept regular human breeding establishments, and the ovens at Bau for cooking human flesh were scarcely ever allowed to get cold. Undaunted by this, however, British Wesleyan missionaries went to Fiji in 1834, and their labours were attended with most remarkable success. Cannibalism was soon a thing of the past, and as stated above 100,000 of the natives are now members of the Wesleyan Church.

Previous to 1849 the islands appear to have been governed by chiefs who were to a great extent independent of any central authority. In that year, owing to some alleged losses inflicted on American citizens, a very heavy indemnity was exacted, and the fact of the principal chief of Bau being made responsible for its collection and payment led to his being recognized as "Tui Viti," or king of Fiji. Subsequently the king found himself embarrassed by the contentions of the white settlers, of whom there were about 2000, and in 1857 he expressed a strong wish to cede the islands to England. The British government, however, although urged to acceptance by Mr. Pritchard the consul, declined. In 1860 another offer of cession was made, but, on the report of Colonel Smythe, was again declined. An attempt to carry out a constitutional government, assisted by ministers chosen from the white population, resulted in confusion and financial embarrassment. On a renewed offer of cession in 1873 commissioners were sent out, who found the population unanimously in favour of annexation, and they reported that it was both feasible and prudent. The Australian colonies were so strongly in favour of adopting the islands that they offered to share between them whatever the administrative expenses might be beyond the Fijian revenue. The British government accordingly decided to yield to the wishes expressed, and in 1874 Sir H. Robinson, governor of New South Wales, accepted the unconditional transfer of these beautiful islands to the sovereignty of the queen. The terrible

plague of measles which succeeded was a most unfortunate inauguration of our rule. Since then the commerce of the colony has made rapid strides, the revenue and expenditure being each about £100,000 per annum.

Until Fiji was annexed there was no British depot coaling station or place of refuge throughout the whole 7000 miles of sea interval between British Columbia and New South Wales. The Sandwich Islands are practically American, the French are established in New Caledonia, and sound policy rendered it advisable that there should be an English maritime station on the great Pacific highway.

FILAMENT, in botany, the part of the stamens which bears the anther. It is sometimes long and slender, hence its name. In some plants it is nearly or altogether absent, and is not unfrequently flat and broad. See STAMEN.

FILA'RIA. See GUINEA-WORM.

FIL'BERT, the fruit of a variety of *Corylus Avellana*, or HAZEL. The term was originally applied to those kinds of nuts which have very long husks, but owing to the number of varieties that have been obtained this distinction, which was never scientific, appears to be nearly disregarded, and nut and filbert are almost synonymous terms, excepting that the wild uncultivated fruit, and those varieties which most nearly approach it, are never called filberts. The cob-nut is a prolific variety.

About Maidstone, and in other parts of Kent, the management of the filbert is better understood than in most parts of this country, and as the soil and other circumstances seem to suit its growth immense quantities are grown for the London market. The filbert is a monœcious plant, having its male organs in one flower and its female in another; and it is a good plan to plant unpruned hazels among the cultivated filberts, in order that impregnation may be effected, as in the caprification of the fig. See FERTILIZATION.

Great quantities of filberts are rendered useless by being attacked by the nut weevil (*Balaninus nucum*), which perforates the nut in its young state, and deposits its egg; in a few days the maggot is hatched, and then feeds upon the kernel. Some recommend the trees to be shaken in June or July, when the insect makes its appearance; but no remedy is known which can be said to be effectual.

In order to preserve filberts in a fresh and plump state, it is only necessary to prevent their parting with their moisture by evaporation. Burying them in heaps in the earth, putting them in earthen jars in a wine-cellar, covering them with dry sand, are all very good plans, and many others equally efficient will suggest themselves.

FILE, a steel instrument having flat or curved surfaces so notched or serrated as to produce a series of fine teeth or cutting edges, which are employed for the abrasion of metal, ivory, wood, &c. A file is distinguished from a "rasp," which is used for working in wood, horn, &c., by the fact that its teeth are produced by a cutting edge which extends across the file, while those of the rasp are produced by a pointed instrument. Files are said to be *single cut* when their teeth are wholly arranged in parallel lines extending across the file at any angle to its length, and to be *double cut* when the first series of teeth are crossed by a second at a different angle. Files are commonly made of cast-steel forged into bars of the required size, and these bars are cut into pieces suitable for making one file each, which are heated in a forge fire, and then wrought to the required shape on an anvil by two men, one of whom superintends the work, while the other acts as general assistant.

The next operation upon the blanks which are to be converted into files is that of softening or lightening, to render the steel capable of being cut with the toothing instruments. This is effected by a gradual heating and a gradual cooling. The surface is then rendered flat and smooth, either by filing or by grinding.

The cutting of the teeth is usually performed by workmen sitting astride upon a board or saddle-shaped seat, in front of a bench, upon which is fixed a kind of small anvil. Laying the blank file across the anvil, the cutter secures it from moving by a strap which passes over each end and under his feet, like the stirrup of the shoemaker. He then takes in his left hand a very carefully ground chisel, made of the best steel, and in his right a peculiarly shaped hammer. If the file be flat, or have one or more flat surfaces, the operator places the steel chisel upon it at a particular angle or inclination, usually about 12° or 14° from the perpendicular, and with one blow of the hammer cuts an indentation or furrow completely across its face, from side to side, and then moves the chisel to the requisite positions for making other similar and parallel cuts. If it be a half-round file, as a straight-edged chisel is still used, a number of small cuts are necessary to extend across the file from edge to edge. So minute are these cuts in some kinds of files, that in a file about 10 inches long, flat on one side and round on the other, there are more than 20,000 cuts, each made with a separate blow of the hammer, and the cutting-tool being shifted after each blow. If the file is flat and both sides have to be cut, the teeth made on one surface are protected by placing a plate of pewter between the file and the anvil. Files of a triangular shape are supported in grooves of lead.

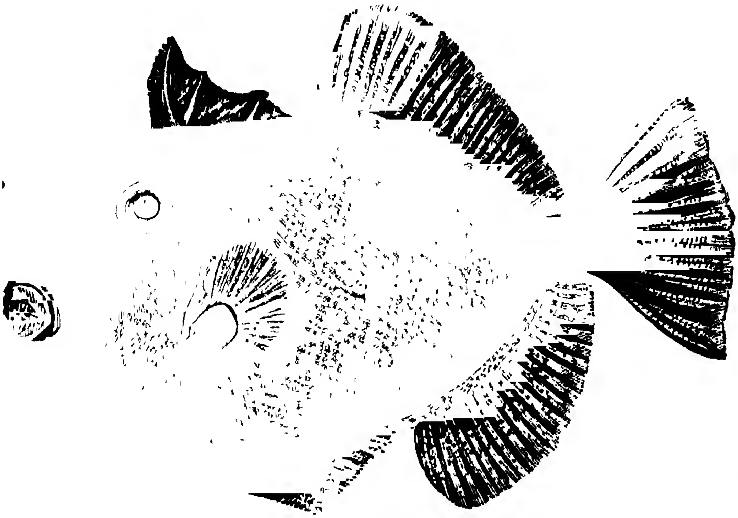
Several highly ingenious machines have been contrived for superseding the tedious operation of file-cutting by hand; but partly from prejudice, and partly from the real difficulty of the problem to be solved, hand labour is still chiefly employed in England, though machinery is extensively used in America. The objection to machine-cut files is the great regularity of the teeth so produced, which repeat and exaggerate any imperfection or inequality. The irregularity in hand-cut files prevents this, and the newest file-cutting machines imitate this irregularity more or less successfully.

After the files have been cut the steel is brought to a state of great hardness. This is effected in various ways, according to the purpose to which the file is to be applied; they are generally coated with a sort of temporary varnish, then heated in a stove, and then suddenly cooled by a plunge into cold water or brine. In some cases they have to be removed before the cooling process is complete, in order that they may be straightened by pressure; they are then cooled in oil. After hardening the files are scoured, washed, dried, and tested.

FILE-FISH and **TRIGGER-FISH** are names given to species of Balistidæ, a family of fishes belonging to the order PLECTOGNATHI. This order is intermediate in point of structure between the bony and the cartilaginous fishes; for the skeleton ossifies very slowly, and is never entirely complete; the vertebræ are few in number, and the ribs in particular usually remain imperfect throughout the whole period of life.

The file-fishes are particularly distinguished by the vertical compression of the body, by having eight incisor-like teeth arranged in a single row in each jaw, and by having their body covered with small scale-like or rough plates. They have two dorsal fins. The first dorsal is composed of powerful spines, the first of which is stout and roughened in front like a file; in the typical file-fishes (Balistes), as will be seen from the cut, it is followed by one or two small spines, which act as triggers to fix it in an erect position, and when disengaged allow it to fall back into a groove. The second dorsal fin is large, soft, or without spines, and placed opposite to an anal fin of similar structure. The ventral fin is quite rudimentary or entirely absent, reaching its highest development in the genus Triacanthus, where it is formed of a pair of strong movable spines joined to the pelvis. The intestinal canal is large, but without cæca, and the air-bladder of considerable size.

These fish abound in all the seas of the torrid zone, where they swim on the surface of the water, particularly in the neighbourhood of rocky coasts and coral reefs, feeding with avidity upon the polyps of the reefs, and shining with the most brilliant and varied colours. They also feed on molluscs, chiselling a hole with their teeth into the shells, in this way doing great injury to the pearl-fisheries. The



Gilded File-fish.

species of the genus Balistes are easily distinguished by the rhomboidal form of the small scale-like movable plates with which their body is covered, disposed in regular rows, and merely touching at their edges, and thus giving the whole body the appearance of being divided into so many regular compartments.

In the genus Monacanthus the body is covered with small thickly-set spines, of forms varying with the species, and occasionally resembling in fineness and closeness the pile of velvet. Two species of the genus Balistes, common in the Atlantic, are sometimes captured on British coasts.

FIL'EY, a village and favourite watering-place of England, in the county of York, with a station on the Hull and Scarborough Railway, 7 miles from the latter place, and 217 from London. It has a fast-increasing popularity as a watering-place, several good hotels, good water-works, and is well drained. The neighbourhood is full of interest, especially to geologists. On some sunken rocks which project to the south, and are visible only at low water and spring tides, there is a rude building, which is supposed to be of Roman date, Filey having been the Portus Felix of Ptolemy. Population in 1881, 2337.

FIL'IGREE (Lat. *filum*, a thread, and *granum*, a grain), an ornamental kind of work, in gold or silver, which has the appearance of threads or grains—the filaments being braided and festooned in different ways, according to the taste or skill of the artist. In India the art is extensively practised; and the articles usually made in gold and silver filigree are brooches, earrings, bracelets, caskets, small boxes, groups of flowers, chains, &c. But the design best adapted for displaying the delicacy and beauty of filigree is that of a leaf. The apparatus used in the art is extremely simple, consisting merely of a few small crucibles, a piece of bamboo for a blowpipe, small hammers for flattening the wire, and sets of forceps for interweaving it. The gold and silver wire made by the Hindus for this and other purposes is of varied character, according to the purposes for which it is intended; thus the *goolabatoon* is made at Dacca, for the embroidering of muslins and silks; *goshoo*, for caps, and for covering the handles of chowries; *sulmah*, for turbans, slippers, and hookah-snakes; and *booiun*, for gold lace and brocades. For some of these purposes it is not strictly wire, but gold thread; that is, silk covered with silver, and then with gold. The ancient Etruscans and the Irish of the eleventh and twelfth centuries brought the art to great perfection. Filigree work is sometimes called *Maltese work*, much of it being done in Malta. This manufacture is also carried on in Italy, Albania, the Ionian Islands, and many parts of Greece.

FILIPE'PI, ALESSANDRO. See BOTTICELLI.

FIL'LAN, ST., a Scottish ecclesiastic, probably of the eighth century, who had a church at Strathfillan (which takes its name from St. Fillan), in Perthshire. A monastery dedicated to St. Fillan was erected or restored at Strathfillan, in the fourteenth century, with the assistance of King Robert Bruce, who attributed his victory at Bannockburn to the possession of a relic (an arm bone) of the saint. Another relic (the silver head of a crosier), which was long supposed to possess miraculous powers, is now preserved in the National Museum of the Society of Antiquaries of Scotland.

FIL'LET, a flat rectangular moulding, of very frequent occurrence in architecture. It is used to terminate or divide other mouldings, as in the cavetto, which is surmounted with a fillet, and in the flutings of columns, which are divided by a fillet. The fillet is much used in entablatures.

FILLIBUSTERS. See BUCCANEERS.

FIL'TER, a strainer used in chemical operations for rendering fluids transparent by separating the suspended impurities which make them turbid, or for separating and washing the precipitates resulting from chemical analysis.

The simplest filters are made of unsized paper; and these are used either spread out upon cloth stretched upon a wooden frame, or folded and placed in funnels, and having consequently the form of an inverted cone. They are either single or double, according to the purposes to which they are to be applied. In some filters the paper is made into a pulp and mixed with the liquid to be filtered. Various forms of filter are employed for the purpose of filtering water, either for drinking or culinary purposes. These filters generally depend upon passing water through sand or small pebbles and charcoal, and sometimes through solid porous blocks of compressed carbon. Loam and clay are also used; but charcoal, especially that obtained from burning bones, is much more efficacious, and is now generally adopted for removing organic matter from drinking water. A filter of animal charcoal will render porter colourless; it will also remove from water some of the poisonous alkaloids. It is well known that the Thames and other river waters, though they contain but little saline matter in solution, are frequently turbid, owing to mechanical admixture of earthy matter, which the filters in question are well calculated to remove, so as to render the water, though not so agreeable as spring water for drinking on account of its flatness, yet well adapted for other purposes. Air-filters are applied to the outlets of sewers and other openings

from which poisonous gases issue, and are found to render the air pure and inodorous. These are usually formed of large pieces of wood charcoal. Charcoal respirators are small air-filters of the same kind applied to the mouth.

Intermittent filtration is applied to the oxidation of sewage by allowing it to percolate for some time through a filter of earth, which is periodically allowed to rest, and becomes reoxidized by exposure to the air.

Cotton wool, pyroxilin, asbestos, powdered glass, magnesia, are all employed as filtering media.

Filter-press.—This apparatus is largely used in many manufactories for separating fine solids from liquids. It assists filtration by applying hydraulic pressure; the filtering cloths are contained between horizontal plates, and the liquid to be filtered is pumped into the centre of the cloths. The hydro-extractor is another method of assisting filtration. In this apparatus, of great use in sugar refineries, and where crystals have to be separated from the mother liquor, the filter, a wire cage, is revolved on a firm axis at a high rate of speed, and the liquid thrown out by centrifugal force, the crystals being retained in the revolving cage.

FIN WHALE. See RORQUAL.

FINA'LE, the concerted piece of music by which the acts of an opera conclude; the last movement of a symphony, concerto, &c.

FINANCE, a term used to express the art of dealing with money matters. In the plural it is often used for money itself, sometimes with reference to private wealth, but oftener, and more properly, to the public funds. There is a special connection between finance and taxation; hence in Belgium there is a minister of finance, also in France, Austria, Germany, and other countries, corresponding with our chancellor of the exchequer. Many statesmen have been called eminent financiers—as Necker and Fould in France, and Pitt and Gladstone in England—from their ability to adjust national taxation and expenditure. The comptroller of finance for the time being has to count the cost of, and raise the funds for, any war in which the state may be involved. He has further to impose and repeal taxes. Turgot said that finance was the art of plucking the fowl without making it cry. Indirect taxation is imposed on this principle; and though taxes so raised are more easily collected, and less felt by the tax-payers, than direct ones, yet when unduly assessed they are found to prejudicially affect the trade and wealth of nations.

FINCH is a name applied to many birds of the order PASSERES and division Conirostres. The word finch, which appears in German as *fink*, is derived from the call-note of the chaffinch, which resembles the sound of the syllable *fink* or *pink*. The chaffinch is even now known in some parts of England by the names pink, spink, and twink. The word finch has come, however, to have a very much extended meaning. Besides occurring as the last syllable of the popular names of many well-known little birds, as bullfinch, chaffinch, greenfinch, hawfinch, it is used to denote the large family of Passerine birds with conical bills, called by ornithologists Fringillidæ. The limits of this family are very uncertain. By some naturalists it is so extended as to embrace the whole suborder Conirostres; others remove not only the tanagers, weaver-birds, and larks, but also the crossbills and buntings. See FRINGILLIDÆ.

FINDING, LAW OF. The finder of lost property is the owner of it against all the world except the original owner; but the owner may reclaim it from the finder at any time, and the latter is bound to use every means within his power to discover the former. If he knows the owner, or there are circumstances which, if he choose to profit by them, would lead him to the owner, a conversion of the property to his own use is accounted larceny or theft. In the case of Merry *v.* Green, Baron Parke thus explained the law—"If the finder knows who the owner of the lost chattel is, or if, from any mark upon it or the circumstances under which it is found, the owner could be reasonably ascertained, then the fraudulent appropriation, *animo furandi*, constitutes a larceny. Under this head fall the cases where the finder of a pocket-book with bank-notes in it, with a name on them, converts them to his own use; or a hackney-coachman, who abstracts the contents of a parcel which has been left in his coach by a passenger whom he could easily ascertain; or a tailor, who finds and applies to his own use a pocket-book in a coat sent to him for repairs by a customer whom he must know; all these have been held to be cases of larceny." The finder has all the rights of action of an owner, either to recover possession of it, or damages for loss of or injury to it. Upon restoring the lost property the finder may demand from the owner all his expenses incurred in keeping and preserving it, and in some instances may make a further charge for compensation for care and reward. The Scotch law appears to be the same (see M'Kinnon, 25th May, 1863; 4 Irving, 398). With respect to the law as to treasure trove see TREASURE TROVE.

FINE ART. In the article ART it is pointed out that a convenient distinction is drawn between the useful arts, which subserve the preservation of life, and the fine arts, which minister to its higher enjoyment. But the distinction must not be held to imply a difference; for who would maintain that cookery cannot be made to call up æsthetic feelings, or who would deny that a sonata of Beethoven conduces, by the stir and rouse of the mind, to the actual increase of vitality in a properly constituted listener? In fact every useful art has its fine-art side, and every fine art has its useful side.

The end of the fine arts and their characteristics are very definite. For a work to partake of the character of fine art it must address itself to one of the two æsthetic senses, the eye or the ear; and it must have as its end, to arouse the æsthetic emotion, namely, the delight at the perception of the *sublime* or *beautiful*. Further, a work of art (by which term a work of fine art is always understood) will possess three remarkable characteristics. It aims at pleasure, it avoids all disagreeable accompaniments, and it possesses in some sense universality. The whole world may enjoy a picture, a statue, a poem, or a symphony so far as the works themselves are concerned—they are universal. The whole world could not enjoy a house (except architecturally, that is, on its fine-art side), nor a fortune, nor a dinner. These are pleasant, and have possibly no disagreeable associations (though that is unlikely), but they are restricted and selfish, and therefore unæsthetic. At the same time the representation of things which are sensual or selfish (restricted) in themselves, is artistic. So with the sensual muscular delight of a cricket match; it takes on a fine-art character when it is beheld as a beautiful spectacle by the critical onlooker. The second criterion, the avoidance of disagreeable feelings, as fatigue, &c., is then fulfilled; and the third criterion is also fulfilled by the newly-gained character of universality, since, while only thirteen men can play at once, thousands may look on.

The rivalry of the two senses to which fine art appeals is never-ending. Music appeals to the one, painting (with sculpture) to the other; and to the end of time some men will be more moved by painting, others by music. Music is peculiar in that it creates its own medium, and is only appreciated in actual motion, while the tone is yet vibrating (or of course, in the memory of that motion); while painting is limited to delineation of some distinct fact, and to one instant of past time. Further, painting in the hands of the greatest artists can call up emotions or states of the mind, and this apart from any story told in the picture by expressive figures or faces, since it is to be accomplished in landscape. To name one example, Turner can make his spectator gay or sad by the mere play of

colour. But what is occasionally accomplished in painting is the very home of music. Unable to depict definite objects like painting, it is able to arouse with the greatest accuracy mental states. A whole audience shall be made to vibrate with one common emotion, though perhaps hardly two shall think of the same definite cause of that emotion. The feelings a "southerly wind and a cloudy sky" raise in the mind of the huntsman, the sight of his beloved hastening to meet him in the mind of the lover, the sight of crowded benches and hushed attention in the mind of the orator, closely resemble each other. It is in the power of music to set the huntsman, the lover, and the orator aflame at a pitch of glad suspense all with the self-same inspiring strains. If as in the song, definite ideas be used, the poem is robed by music in its appropriate emotional colour; and this is an effect of the same class as that of the emotion-causing landscape alluded to above. Given the tree or the poem, and the colour or the phrase of tone sets the critic in the proper frame of mind for seeing it at its best, the tone (for the generality of men) being by far the more accurate and vigorous of the two.

Harmony of tones, repose and purity, symmetry of form, variety in unity, an exquisite fitness and order, and adaptation of means to ends, as well as a power of suggesting more than appears—an imaginative power—are all essentials in every work of fine art. The latter quality pushed to excess yields the sublime in art—the sublime of power, the sublime of space, the sublime of time. All these attributes are finely combined by Ruskin, in his "Modern Painters," into a sort of religion of the beautiful. Infinity, he says, is a type of the divine incomprehensibility; unity is the type of the divine comprehensiveness; repose is the type of the divine permanence; symmetry that of the divine justice; purity that of the divine energy; moderation that of the divine government by law.

The importance of the curve in form and in colour (gradation of tints), and the closely corresponding rising and falling of musical tones, and their waxing and waning, lies in the suggestion of infinity which they convey. Straight lines and level tints, simple harmonies and even sounds, are valuable only (or in greatest part) as the foils to throw up the higher beauty of the curve.

The foregoing remarks will be found to apply to every fine art, though they have been chiefly drawn from the consideration of painting and music. The principal fine arts are these:—Music; painting, sculpture, architecture; poetry, romance, drama; oratory, acting, dancing. The grace of manners is also fairly to be called a fine art, but it is compounded of some elements of several of the others, rather than having any distinctive character of its own.

The moral influence of fine art is twofold. Firstly, it refines and elevates the mind in a manner not attainable by any other agency; it lifts a man out of himself, and sets him for the time above all petty cares of the world. The auditor of a play of Shakspeare lives for the moment a life upon a higher plane than that of his every-day existence, and if he is thoughtful he will be compelled to strive to render this elevation, or some approach to it, permanent in action. But secondly, fine art has an enervating influence which is sometimes disastrous. A man who lives only to feast upon the drama is a useless creature in actual life; overgreat indulgence in the creations of the brain unfits for the active business of the world. It is a mental opium-eating. Away from his study the poet often seems beneath the level of the general intelligence; the anecdotes of the mistakes and follies of artists absorbed in their dream-clouds are countless, and should be instructive. The disastrous result of nations abandoning the actual for the ideal, instead of using the ideal to elevate and ennoble the actual, stands recorded in history.

FINE OF LANDS, one of the modes of conveying lands and hereditaments by matter of record. It was so called because it put an end (Lat. *finis*) not only to the actual suit of which it was the conclusion, but also to all other suits and controversies concerning the same matter. Divested of its technicalities, a fine may be described to have been an amicable composition or agreement of a suit, either actual or fictitious, by leave of the king or his justices, whereby the lands in question become, or are acknowledged to be, the right of one of the parties.

A fine was principally used as the mode of conveying the estates of married women, and renouncing their right to dower, as a means of barring estates tail, and remainders and reversions dependent upon other estates, and also for the purpose of strengthening defective titles.

By the 3 and 4 Will. IV. c. 74, fines were abolished, and provision made for the conveyance of the interests of married women in land, with the concurrence of their husbands, and after being examined to ascertain if they are acting voluntarily.

The phrase is unknown in Scotch law, as the procedure is unnecessary. When all having interest agree, defects in titles to land can be cured by executing and recording the appropriate deed; and the direct remedy afforded by the action of *declarator* does away with all necessity for fictitious suits.

FINES among our early English kings were very favourite punishments. There was an appropriate fine for almost every offence, called *bot*, as between man and man, or *wite*, as between a subject and the king. Thus the *bot* for a wound an inch long in the face was 3*s.* (laws of Ethelbert), and for the loss of an ear 30*s.* Murder even was redeemable by paying to the relatives of the murdered man a WERGILD, varying in value with the rank of the victim. A man who refused to pay either *bot* or *wite* became an outlaw, and they who were injured took their remedy in whatever way they found possible.

Norman sovereigns filled their coffers sometimes with fines, not confining themselves to the use of fines merely as punishments, as their predecessors; and the charters therefore are full of provisions against excessive levying of fines by the king—*e.g.* Henry I.'s Charter of Liberties (1100), Magna Carta (1215), the Statute of Westminster (1275), &c.

But the Tudors were the greatest finers, and Henry VII. was the worst of all. He not only filled his exchequer, but he aided his set purpose of weakening the great nobles by his heavy fines. For instance, having passed a law against the keeping of a large body of turbulent retainers, who perpetuated the strife of the Wars of the Roses, he visited the Earl of Oxford; and upon the earl assembling a body of men in his livery to do honour to the king, he was met by the fine of £15,000, an enormous sum in those days. See EMPSON and DUDLEY.

The Stuarts, parodists of the great Tudors, all whose faults they imitated without one of their virtues, did not fail to improve upon these models; consequently James I., by means of the Star Chamber, extorted very great sums indeed; and Charles I. went still further, fining Lord Salisbury £20,000, Lord Westmoreland £19,000, and Sir Christopher Hatton £12,000 for trespassing on the royal forests, &c.

FIN'GAL. When Macpherson formed his "Poems of Ossian" on the basis of old Irish and Scotch Gaelic traditions, he changed the name of the Gaelic hero from Finn or Find to Fingal, and his kingdom from Ireland to Morven in Scotland. The Finn of tradition was the Rig or king of the Leinster Finns or FENIANS just before historic times, and is said to have resided at a *dun* or fort at Almhain, the present Hill of Allen, in the county of Kildare. That such a chief as Finn had a real existence is very probable, but his true history is lost in the myths and legends that have surrounded his name.

FINGER. See HAND.

FINGER-BOARD. This is the name given to the front part of the neck of a violin or of a guitar, &c., whereon the fingers press in "stopping" the strings. The effect of pressing the string against the finger-board is to shorten the sounding length of the string, and therefore to cause it to sound a higher note than when the whole length is vibrating. In this way, by "stopping" further and further from the nut, that is, nearer and nearer to the bridge, higher and higher notes are obtained.

The actual face of the neck is not used, because it would wear away, and also because the strings could only be stopped to where the neck joins the body. An ebony finger-board is therefore glued on to the neck of the instrument, carrying a little ridge or nut at the top so that the strings are lifted a little above it at starting, in order that their vibration may be free, and projecting considerably towards the bridge over the body of the instrument beyond the neck, in order that very high notes may be produced. The finger-boards of violins, &c., are smooth, but those of guitars and banjos have transverse frets to assist the player in producing the notes, an arrangement originating in the viol da gamba and other ancient viols.

FINGERING is the name given to the mode of playing any musical instrument in which the fingers take part, so far as that part is concerned. Thus we get the fingering of the left hand as a most important branch in the playing of stringed instruments, and the fingering of flutes, obos, clarionets, and bassoons, in that of the "wood wind;" brass instruments with pistons, as cornets and some sorts of horns, demand great attention to the fingering; and finally, the organ and pianoforte require fingering alone to produce their tones.

In the organ, so soon as the great levers struck by the fist had become keys to be moved by the fingers, fingering became possible; and long before the pianoforte was invented the width of keys had been brought down to about an inch, so that an octave could be stretched with ease. But it is very curious to notice how late in the history of the keyboard the complete use of all the fingers occurs. The thumb and little finger were but little used except in playing wide intervals or chords; scales were universally performed, even down to 1700, with the first three fingers only. We meet with the following quaint question and answer in the fine old manual of Ammerbach (Leipzig, 1571): "But what are you to do with the thumb? You cannot let it stick up in the air; and in consequence it must rest on the wooden front rail of the keyboard. There it is both out of the way and does not hang idle, and in addition it serves at least to support the hand." It was Bach who first made use of all the fingers and the thumb, still passing the long fingers over one another occasionally, as in the older method. He perceived the immense advantage the flexibility of the thumb gave to rapid fingering; passing it under the hand, which then swings across and over it as on a fulcrum, we smoothly and instantly attain the grasp of another group of notes; and this it was Bach's merit to teach. The necessity for a new departure was evident; for the system of tuning all keys alike [see TEMPERAMENT], also due to this composer, brought the black keys into perpetual use, instead of their serving, as before, mostly as accidentals for the simpler keys. The key D♭, for instance, which uses all five black notes, was an impossible key before Bach. Passing the long fingers over one another is now quite abandoned, all change of position, other than by leap, being accomplished by the thumb.

It is usual not to use the thumb on black notes too freely, the reason being evident when the shortness of the thumb is considered. In all systems of fingering the hand is kept as steady as possible, and if the thumb is used much upon the black notes the hand will be found to move backwards and forwards and up and down. Without being pedantic in pushing the principle to extremes, the back of the hand should be kept at one level, moving smoothly to right or to left, and not in any other way, in long passages of fingering. Nevertheless, in modern playing many passages occur when to adhere rigidly to this rule would be to court failure.

In England the fingering, when expressed by figures above the notes, is usually written × 1 2 3 4, the cross being for the thumb; but on the Continent the fingering is 1 2 3 4 5, the thumb counting as the first digit. This makes the fingering of foreign editions a little difficult for English players to read. Some English writers have endeavoured to introduce the foreign fingering, but as yet with small success.

FIN'IAL, the ornament of the point of a spire or pinnacle in Gothic architecture. In fact, the finial is the gathering up of the various lines of crockets or leaf-like tufts of ornament decorating the edges or ribs of the spire, &c. The finial is in essence a bunch of such leaves, formally arranged in a group of three or four round a central stem, which rises from their midst to form the apex of the construction. But starting from this form the infinite variety of Gothic architecture developed a number of very beautiful finials. Finials from Lincoln and from Westminster Abbey will be found upon Plate III. of ENGLISH CATHEDRAL ARCHITECTURE.

After the degeneration of Gothic architecture the finial became a mere spike or point, or a ball, or a spike coming out of a ball, &c. These balls and spiked balls, on gate posts or at the foot of a flight of steps, are common among us; but few consider that they are the fallen representatives of the graceful finial.

FININGS. In brewing and other manufacturing operations a process of clarifying or clearing is sometimes required, for which some substance capable of precipitating or raising to the surface certain impurities is employed under the name of fining. Isinglass, or the white of eggs, is most generally employed, and is made into finings by mixing it with beer or cider, stirring it until the isinglass is dissolved, straining through a sieve, and finally bringing it to a liquid state by mixing with the same kind of beverage as that which is to be fined. Malt liquors thus fined do not afterwards stand well on draught. Distillers or rectifiers in clarifying gin and cordials use a fining composed of alum mixed either with carbonate of soda or salt of tartar and hot water.

FINISTÈRE or **FINISTERRE** ("land's end"), a department of France, which comprehends the greater part of Basse Bretagne, is bounded N. by the English Channel, E. by the departments of Côtes du Nord and Morbihan, S. and W. by the Bay of Biscay and the ocean. It extends between 47° 44′ and 48° 47′ N. lat., and between 3° 22′ and 4° 50′ W. lon. Its greatest length from north to south is 78 miles, from east to west 63 miles; but the average breadth does not exceed 44 miles. The area is 2595 square miles, and the population in 1886 was 707,820. A vast number of islands and rocky islets lie off the coast. The most important of these are—*Ouessant* (Ushant), 13 miles from the mainland; the group of the *Balances* and the isle of *Beniguet*, which lie between Ouessant and the Cape St. Matthieu, at the entrance to Brest harbour; *Sein*, a low, barren, and rocky island, nearly two miles west of Cape Raz, inhabited by fishermen; and the *Glenans*, a group of nine islands on the south coast, opposite Cape Trevignor.

The department presents to the sea a bold barrier of granite rocks, at the foot of which there are here and there extensive sands and beeches. The coast-line measures above 360 miles, reckoning all its windings; it is indented by a great number of bays and inlets, corresponding to an equal number of valleys or depressions in the land, out of which flow as many rivers or brooks. The largest of these inlets are on the west coast, forming the harbour and

roads of Brest, the Bay of Douarnenez, famous for its pilchard fishery, and the Bay of Audierne. The coast is dangerous to mariners, and exposed to great storms from the south-west. Lighthouses are built on all the principal headlands. The interior of the department is hilly; two offshoots of the Armoric range cover a great part of the surface, namely, the Arrée Mountains in the north and the Montagnes Noires in the south; but they nowhere exceed 1000 feet in height. The number of Druidical stones in this department is great.

The rivers are very numerous, but their course is short. The most important are—the Aulne, which flows from Côtes du Nord westward, past Châteauneuf and Châteaulin; from this last town to its entrance into Brest Roads it is a tidal river, and navigable; its principal feeders are the Elèze, the Doufine, on the right bank, and the Hière on the left: the Elorn, which also enters the Brest Roads, and forms the harbour of Landerneau: the Odet, which passes Quimper, where it receives the Benodet, and becomes navigable to its mouth in the Bay of Benodet: and the Ellé, which enters the south-eastern angle of this department from that of Morbihan, receives the Isok or Issole at Quimperlé, whence to its entrance into the Bay of Biscay it separates Morbihan from Finistère. The scenery along these rivers is exceedingly beautiful, and in most of them there is good trout-fishing.

The best soils are near the coast or in the neighbourhood of the rivers. The old district of Léon, which forms the western part of the arrondissement of Morlaix, is the best soil in all Bretagne; but the eastern part of the arrondissement, which is called Tréguier, is poor and ill cultivated. The arrondissement of Brest comprises some very fertile lands; a large area is appropriated here to the growth of strawberries. With the exception of the canton of Pont l'Abbé, which consists of excellent well-tilled soil, the arrondissement of Quimper has but little good land. The arrondissement of Quimperlé is a pretty and well-wooded country, but the soil is in general light. The most unproductive part is the arrondissement of Châteaulin, which consists almost entirely of vast moors and heaths. Here the people are for the most part shepherds and cattle-breeders. The cattle are all of the small Breton breed. Although some advance has recently been made, modern improvements in agriculture have not yet been generally introduced into Finistère, and the methods adopted in some parts are still very old-fashioned. Nevertheless, more wheat and rye are produced than are required for home consumption. Barley, oats, buckwheat, great quantities of pease and beans (which form a large part of the food of the pasantry), and kitchen vegetables, are also grown. Other objects of cultivation are flax, hemp, tobacco, and cider fruits. Besides the animals before mentioned, great numbers of excellent pigs are bred. Bees and game (deer, partridges, &c.) are abundant. Eels, trout, salmon, lobsters, and oysters are plentiful; but the pilchard and anchovy fisheries along the coast afford the most profitable occupation to the Breton fishermen. These fisheries, as in all similar circumstances, form an excellent nursery for the French navy, which draws its best seamen from Bretagne.

Iron, coal, silver and lead, bismuth, and zinc mines are worked. An excellent stone, easily worked, and capable of resisting the action of the weather, is found at Daoulas and one or two other places near the Brest Roads; it is of a light green colour, and when worked presents the appearance of bronze. It is called *Kersanton* stone, and of it several churches in the department are built. Granite, marble, building stone, and slates are quarried; potters' clay, kaolin, and whetstones are found. There are cold mineral springs at various places in the department. The manufactures consist of sailcloth, linen, soda, soap, seed, oil, candles, ropes, pottery, paper, leather, refined sugar, litharge, and tobacco. Shipbuilding is carried on at Brest, and in most of the large towns on the coast. The commerce of the department is composed of the various products already named, in addition to which may be mentioned wine, brandy, beer, cheese, butter, salt, and colonial produce.

The climate is damp and foggy; the average number of rainy days in the year is 220; sometimes the rain falls, almost without cessation, for weeks together. Frost and snow are rare. Fine days are few, even in summer; and in the same day one may experience the climate of the four seasons, so great is the variation of temperature. Storms are very frequent along the coasts, and nowhere in the world are the terrible sublimities of a raging sea seen to greater advantage than near the village and promontory of Penmarck; the sound of the waves dashing against the rocks is often heard to a distance of 12 or 18 miles inland. The prevailing winds are the west, south-west, and north-west.

The Bretons are an interesting people, strongly attached to their religion, their old customs, and to their language, which is a dialect of the Celtic. Most of them understand French, but it is not much used in common conversation. The people are somewhat brusque in their speech and manner, but kind-hearted and hospitable. In the fertile parts they are handsome, vigorous, and well formed, and make excellent soldiers and clever and courageous sailors. In the mountains and marshes they have a mean and poor appearance, and their habitations there are mostly long, narrow, smoky huts, with a single window, and divided by a frail partition into two apartments, one of which is occupied by the man of the house, his wife, and his children; the other contains the cows, calves, pigs, and other animals of the farm.

The department is divided into five arrondissements, viz.:—Quimper, which takes its name from the chief town of the department, Brest, Châteaulin, Morlaix, and Quimperlé.

FIN'LAND, GRAND DUCHY OF, an administrative division of the Russian Empire. It lies between 59° and 70° N. lat. and 20° and 32° E. lon. On the north its boundary is Norway; on the north-east, the government of Archangel; the east, Olonetz; the south-east, St. Petersburg; the south, the Gulf of Finland; the south-west, the Baltic; the west, the Gulf of Bothnia; and the north-west, Sweden. Its area is about 145,000 square miles, and the population in 1884 was 2,100,000.

The surface of Finland, in the eastern and central parts, is intersected by lakes, rivers, and swamps, between which there are flats of sand overgrown with moss and studded with low hills. In the northern and western parts it is covered with mountains belonging to the great Scandinavian chain. In the more southern latitudes the valleys between these mountains contain good arable and meadow land. The coasts are lined with precipices, reefs, and rocky islands, which render navigation very hazardous. The centre of Finland is an elevated plateau, from 400 to 600 feet above the sea, full of lakes, and covered with low rocky elevations, mostly composed of red granite. Besides Lake Ladoga the chief lakes of Finland are those of Saima and Enare. The rivers, none of which are large, are the Voxa, Kymmene, Kumoyoki, Yanaus, Sestra, Tornea, Muonio, the Tana-elf, and some others.

Finland is very swampy, and is severely cold in winter; but the climate appears to be on the whole salubrious. There are extensive forests of firs and pines in the south, interspersed with oaks, elms, &c. In northern Lapland these trees are replaced by the birch, until in the coldest districts trees cease altogether. The chief crops are cereals, vegetables, hemp, flax, hops, and tobacco; but the produce is seldom large. The forests yield much timber, pitch, and potash. Fowl and other wild game are plentiful.

Bears, elks, wolves, foxes, martens, &c., afford a large supply of furs and skins. Reindeer abound in all parts of northern Finland. The streams are well provided with fish, which form the chief food of the people. The minerals are chiefly bog-iron, lead, copper, marble, slate, and chalk.

The majority of the population are of Finnish extraction. They are all free, and many of them are landholders. The workmen are not inferior to those of any country, and their timber dwellings are in fair condition, comfortable, and snug. Light and fresh air have access everywhere in the towns, the broad streets of which present quite a rural aspect. The squalor and filth generally characteristic of great cities are scarcely known in Finland. All the inhabitants, except about 42,000 Greek Catholics, belong to the confession of Augsburg. There is a university at Helsingfors, grammar-schools in Wiborg, Abo, and Borgo, and inferior schools in most of the parishes.

Agriculture, the breeding of cattle, and in some parts the fisheries, constitute the principal occupations of the people. Great efforts have been made by the Russian government to increase the agricultural capabilities of the country, but the climate and other natural obstacles seem too great to be overcome, especially in the north. For ten years previous to 1868 the crops proved more or less a failure, and the distress caused by the failure of 1867 was so great that fully one-tenth of the whole population died of famine-typhus. After 1868, however, there was a series of good and abundant harvests, which, coupled with a lively demand for the exports of the country, brought a considerable measure of prosperity. The manufactures are of increasing importance, and comprise extensive iron produce and works, spinning-mills and powerloom manufactories of cotton, linen, woollen stuffs, and yarn, paper making, sugar refineries, candle and soap works.

The total annual value of the exports from Finland is about £1,200,000, the chief articles being deals, tar, iron, and butter. The value of the imports—consisting principally of cereals, sugar, coffee, and manufactured goods—amounts to £2,000,000. Several lighthouses and beacons have been erected along the coast.

There is a distinct establishment at St. Petersburg for the government of this vast principality, and direct railway communication exists with the Russian capital. The governor-general, who resides at Helsingfors, has chiefly military duties to discharge. The duchy is divided into eight provinces.

The name Finland is said to be derived through the Swedish translation of the Finnish *Suomi* or *Suomenniæ*, or Swampy Land. The Finns have a sort of constitution, and the forms of independence still kept up flatter the national feeling. The forces raised in the country are not mixed with the Russian army, and their fleet, the best manned of the navy, sails under the Finnish flag. There is a convocation of states, representing the four social orders; this sanctions all new laws and the imposition of new taxes. The emperor exercises supremacy as grand duke. The procedure in the law courts accords, in form at least, with the practice in Sweden. Prior to the Swedish conquest in the twelfth century, they had their own kings, and were pagans. The kingdom of Permia, near the Ural, whose people were also Finns, at first conquered by the Norwegians, was afterwards absorbed by Russia. In 1721 Peter the Great conquered the eastern province, Wyborg. The country was finally taken from Sweden at the close of the war of 1808, but though the transfer was repugnant to the inhabitants they have never demonstrated against it with the same distinctness as Poland. The patriotism of the people and their independence of sentiment, however, is quite as vivid and sincere. By loyalty and suavity to the ruling power Finland has been able to preserve its own language, its own religion, and a modified version of its own laws; while the University of Helsingfors has been left to regulate itself exactly after its own designs, as a centre of Finno-Swedish culture. See FINNS.

FINLAND, GULF OF. See BALTIC SEA.

FINNISH LITERATURE. The Finns as a people are the possessors of an extensive indigenous literature, consisting chiefly of poetry, songs, proverbs, and charades. The great monument of their literary activity, however, consists of a remarkable epic poem, the "Kalewala," which although it had been sung and recited in fragments for ages by the Finnish harpers was not written or printed until the present century. A small collection of these scattered portions was published in 1822 by Dr. Topelius, but it is to Dr. Elias Lönnrot of Helsingfors that the world is indebted for the fullest and most complete collection. To obtain the necessary materials Dr. Lönnrot spent several years in the district of Karelia, wandering from place to place, and collecting from the lips of the peasants and singers their cherished songs and chants. By this method he obtained a series of songs extending to some 12,000 lines, which he arranged in thirty-two rimes or cantos, and published in 1835. It attracted but little attention for several years, but in 1840 it was made the subject of discussion by the Academy of Dorpat, and the attention of the scholars and philologists of Europe became directed to this remarkable monument of antiquity. Dr. Lönnrot had in the meantime continued his researches, and in 1849 he issued a new edition of 22,793 lines, arranged in fifty cantos. The poems are concerned entirely with the Finnish mythology, and describe the battles of three heroes of the land of happiness against their enemies from the land of darkness, and their final victory. Written in eight-syllabled trochaic verse "Kalewala" possesses a thoroughly Oriental appreciation of nature, and is marked by a richness of imagery peculiarly its own. It was evidently composed before the introduction of Christianity in the fourteenth century, but beyond this its origin is veiled in obscurity. As to its value as a contribution to the study of mythology and its literary merit, Professor Max Müller declares "Kalewala" possesses merits not dissimilar to those of the Iliad, and will claim its place as the fifth national epic of the world, side by side with the Ionian songs, with the Mahabharata, the Shahnameh, and the Nibelungen-lied. In addition to this poem Dr. Lönnrot has collected and published a collection of 7000 proverbs, 2000 charades, and numerous lyrics, the latter of which are sung by the Finns to an accompaniment of the kantele, a five-stringed harp.

Modern Finnish literature consists chiefly of works devoted to history, religion, and morality, translations of scientific and learned works from other languages, and of some native poetry. There are several weekly papers published in the Finnish language, and the publications of the various learned and scientific societies of Finland have considerable value.

FINNS, a people from whom the present inhabitants of many of the most northern countries in Europe are descended, constitute a large proportion of the population of Eastern Europe, and of the countries adjacent to the Gulfs of Finland and Bothnia and the Frozen Ocean. They are the *Fenni* of Tacitus and the *Phinni* of Ptolemy. They are classed as belonging to the Ugrian race or *Ogres*, and are considered to have a Mongolian origin. Their dominion once extended from the sources of the Obi and the banks of the Volga to the shores of the Baltic, as far as the north-eastern parts of Prussia. The period of their emigration westward is unknown. Being addicted to a wandering life they could not contend against their more settled neighbours, and they gradually fell under the subjection of the Norwegians, the Russians, and the Swedes. They are divided into five groups—the Finns proper, who chiefly inhabit Finland; the Lapps, occupying the extreme north-west of Russia and some parts of northern Norway

and Sweden; the Permian Finns, chiefly occupying parts of the north-east of Russia; the Volga Finns, dwelling along the banks of the Volga; and the Ugrian Finns, to whom the Magyars belong.

The Finns differ wholly from the Slavonians and Livonians. They have an alphabet and language peculiar to themselves, and the latter is said to be peculiarly harmonious and sonorous. The majority are attached to agricultural pursuits; some few tribes are nomadic, and some devote themselves exclusively to hunting and fishing. They are of middling stature, but of a strong robust make. Their characteristic features are a flat face, with hollow cheeks, dark gray eyes, and light brownish hair, a thin beard, and sallow complexion. The Finns are a brave, honest, and hospitable race of men. They have no nobility. The peasant, however, always gives precedence to the citizen or merchant, and holds every servant of the crown in high respect.

FIORDS OF NORWAY, a term of Norse origin, analogous to the Scottish *firth*, and applied to the wild and romantic inlets of the western coasts of Scandinavia. These are remarkable for the extraordinary crystalline transparency of their waters. So perfectly clear are they that the reflection of the mountains is as well defined upon their surface as the rocks themselves, from which it is often difficult at a little distance to distinguish the line that separates the coast from the water.

FIR. See ABIES, PINUS.

FIRDU'SI or **FIRDOUSI, ABU'L CASIM MANSUR,** the most illustrious of the poets of Persia, was born between 916 and 941 A.D., at Shadab, a suburb of Tus in Khorassan. He devoted himself during the years of his youth and early manhood to the study of the early history and legends of Persia, and to the composition of poetry. In the latter he succeeded so well that he was chosen by the Sultan Mahmud, the Gaznewide, to compile and versify a collection of fragmentary chronicles and histories of Persia, which had with great labour been accumulated for this purpose. The sultan promised the poet a golden dirhem for every couplet, and ordered the payment to be made in sums of 1000 dirhems. Firdusi, however, who cared nothing for money for its own sake, but who wished to construct a dyke for his native town, elected to allow the money to accumulate until the poem should be finished. He devoted thirty years to the task, and composed the magnificent epic poem the "Shahnameh," or Book of Kings, in 60,000 couplets. During its composition, through the machinations of his enemies at the court of the sultan, Firdusi had been left at times without assistance, and had been reduced to great privation; and on the completion of the poem the same influences prevailed, and the sultan was induced to send, instead of the promised reward, 60,000 dirhems of silver. When the money was brought to the poet he was so indignant at the breach of faith of which he had been made a victim, that he gave a third of the money to the messenger who brought it, a third to the keeper of the baths where he was at the time, and the remainder he paid to a sherbet seller for a glass of sherbet. He then destroyed some thousands of lines he had composed in honour of the sultan, and wrote in their stead one of the bitterest satires ever penned. This he gave, well sealed, to his friend Ayaz to present to the sultan after a period of twenty days had elapsed, and then in the guise of a dervish set off on his travels. He journeyed first to Tus and afterwards to Bagdad, being well received at the latter place by the caliph El Cader Billah. The enmity of the sultan, who had been bitterly offended, however, followed him to Bagdad, and he was compelled to remove. He visited Ahwaz, and afterwards Kohistan, the governor of which befriended him and wrote to the sultan on his behalf. The latter, repenting of the way in which he had treated the poet, promised full amends, and when Firdusi returned to his native town of Tus he sent him a robe of honour and 100,000 pieces of gold. This came too late, for the poet died in the year 441 of the Hegira (1020 A.D.), while the money was on the way; as the camels bearing the treasure entered one gate of the city, the body of Firdusi was being borne out for burial at the other. His relatives refused to accept the sultan's gift, and it was ultimately devoted to the purpose for which he had intended it, and to the erection of a large caravanserai in his honour. The poem forms the great national epic of the Persians, and it ranks with the greatest poems of the world. It has always enjoyed immense popularity in the East, and though it abounds with the marvellous and the impossible, there is good reason to believe that it is largely made up of the genuine traditions of Persia. The first complete edition of this poem was published at Calcutta in 1829, and since then a complete edition has been published with a French translation at the expense of the French government (Paris, 1840, &c.) The French translation, with an introduction and notes, has since been published separately (Paris, 1876–77).

FIRE OF ST. ELMO. See ELMO, FIRE OF ST.

FIREBALLS, spherical projectiles which can be fired from guns or mortars for the purpose of illuminating the space around a fortress, the works of an enemy, &c. Composed of gunpowder, sulphur, rosin, turpentine, tow, and other combustible ingredients, they burn with great fury, and throw a bright light for a considerable distance. Some projectiles of this kind have been designed for the protection of ships against torpedo attacks, and these take fire and burn when thrown into water. For land service better illuminators have been found in the parachute and star shells which are now manufactured at Woolwich, while the electric light has rendered the use of marine illuminating shells unnecessary.

FIRE-BRIGADE. Down to 1825 all the fire insurance companies of London had their separate establishments of fire-engines; but in that year those of the Sun, the Union, and the Royal Exchange Offices became incorporated, and were placed under one superintendence. The advantage of this combined system of action having been proved, the London Fire-brigade was established in 1832, and until 1866 was supported solely by twenty-nine of the London insurance offices, who contributed to its expenses in the ratio of the profits derived by each from the business of fire insurance. It was managed by a committee of one member from each of the associated companies.

In 1862, however, they communicated to the government their determination to relinquish the maintenance of the brigade; and in 1866 it was placed under the management of the Metropolitan Board of Works, who received gratuitously the whole plant and stock of the old establishment, and also took on its staff of officers and men. The brigade is now supported by contributions from three sources—viz. the insurance companies, the Treasury, and the poor rate, the total amount contributed being about £105,000 a year. Every company that insures in the metropolis pays £35 per £1,000,000 per annum on the gross amount insured, which at present produces about £24,000 a year. The commissioners of her Majesty's Treasury pay for the general protection of public buildings a contribution of £10,000 a year; and a rate of one halfpenny in the pound on the annual value of property rateable to the relief of the poor in the metropolis produces an additional £71,000.

In all that relates to system and perfect organization, the present London fire-brigade is very efficient. It is the model of all other brigades throughout the kingdom, and in comparison with the former brigade it bears about the same relation as locomotives do to stage coaches, or express trains to omnibuses. Under the old system there were seven-

teen fire stations, guarding an area of about 10 square miles, out of the 700 which comprise the metropolitan district. In 1884 there were fifty-five land and four floating stations in an area of about 121 square miles, but so distributed as to guard an area of more than 400 square miles. There were formerly only thirty-six fire-engines, either worked by steam or hand—there are now 167; and the additions have all been of the most powerful engines which can be made, both land and floating. In Paris, which is not much more than half the size of London, and where the houses are all of stone, there is an established fire-brigade of 1742 men. The London brigade consists of 588 men, and considering the interests to be cared for the force is altogether inadequate. The number of men employed on the several watches throughout the metropolis is 108 by day and 253 by night; making a total of 361 in every twenty-four hours. The remaining men are available for general work at fires.

For the purposes of the brigade, London and its chief suburbs are divided into four districts, A, B, C, and D. Each district forms a distinct group by itself, each station in the district being under the charge of a superintendent of the district. All the sub-stations of the groups are connected by telegraph or telephone with their superintendent's station, and all the superintendents' stations are in the same way connected with the headquarters in Southwark Bridge Road. Thus the first call or alarm of fire is transmitted through all sub-stations to the superintendent of the district, and by him to headquarters. So complete is the system that notice of a large fire at Westbourne Park, in 1884, was received at all the fifty-four fire stations within ten minutes of the discovery of the outbreak.

The whole *personnel* of the fire-brigade is divided into seven classes. First come the superintendents of districts, who receive £195 a year, with lodging, light, fire, and uniform. Next are the engineers, who, in charge of sub-stations, get 5*s*. 10*d*. and 6*s*. 10*d*. a day, according to length of service, and have the same perquisites as the superintendents as to lodging, light, fire, and clothes. The firemen of the first class receive 4*s*. 11*d*., of the second class 4*s*. 5*d*., of the third class 3*s*. 11*d*., and of the fourth or probationary class 3*s*. 5*d*. All men disabled when on duty receive full pay till fit to return to it. These conditions are liberal, but at the same time, if good pay is given a great deal is expected in return, and it must be remembered that the risks of the service are very great, both from the effects of weather and the liability to accident. Success in extinguishing fires cannot be attained without a proportionate risk on the part of the firemen. During the year 1883, out of a number of 588 men, there were 393 cases of illness or accident. The firemen's regular duty must be twelve hours a day, and any emergency of fire may make that twelve hours' duty into twenty-four, or even more. A large number of the men have to be on duty every night in attendance on the FIRE-ESCAPES, which are now placed in charge of the fire-brigade. Strange as it may at first seem, all the firemen are chosen from young able-seamen, and nearly all have served in men-of-war. A moment's consideration of the perilous duties they have to perform will show that such a preference is not only wise, but almost necessary. In the first place, sailors come half-educated to their new work from their habits of discipline, their training to keep long hours on duty, their happy faculty of being able to sleep in their clothes, the quickness with which they turn out on the first summons, and, over and above all, their indifference to ladder duties and lofty heights. The latter qualities are the most essential, and long experience has shown that few or no landsmen ever acquire that coolness and self-possession in dangerous positions that sailors enjoy from years of training and force of continued habit. Sailors, therefore, are always chosen, and as much as possible between the ages of twenty-one and twenty-five. It takes six months to ascertain whether or not a man will be suitable, and during this time, though always on duty, he has to go through ladder drill—as to how the ladders are to be joined, the greatest heights to which they may be safely lengthened, and the best parts of a burning house against which to plant them. He has to attend lectures as to the theory of extinguishing fires, and to put these theories into practice every day. He has to learn the reasons for closing lower doors and opening upper ones, or *vice versâ*, to study the component parts of steam and hand engines, so as to be able to take charge in any emergency, together with the management of water-plugs and hose so as to utilize their contents to the best advantage. If he fulfils all these requisites at the end of six months he becomes a regular member of the fire-brigade, and from that time, according to his conduct, his promotion is more or less sure. All the men at the stations take watches night and day. In the first call or alarm all the men are roused by bells, the chief of the district or group is communicated with, and he in turn communicates with the headquarters at Southwark Bridge Road. Three minutes is all the time allowed for the engines and firemen to leave the station after the first call. If the engine is not ready the coachman and watch are fined 2*s*. 6*d*. each for the first offence, 5*s*. each for the second, 10*s*. for the third, and a week's pay for the fourth, after which dismissal follows, and in all cases a fine of this kind disqualifies a man for six months from promotion—therefore stopping for so long the increase of his pay by 6*d*. a day. The firemen who miss the engine, that is, who are not on it *within* three minutes after the first call or alarm, are fined in the same proportion. Yet the fines received are almost nominal in amount, for, as a rule, two and a half minutes is the time taken at all stations from the moment of the first alarm till the engines and firemen are in full career towards the fire.

The introduction of street fire-alarms has frequently proved of great service, though they offer great temptations to the badly or mischievously disposed, but the severity of the magistrates, and the growing disposition of the public, which would place anyone discovered tampering with an alarm post in a serious danger of summary and deserved punishment, may be trusted to check any interference with them. By means of these instruments, when the bell-pull in the street is drawn out, a continuous ringing is kept up in the head station until the officer of the watch comes to the instrument. The bell is in communication with several street alarms, and in order to tell from which of them the signal comes the officer passes an indicator slowly round a dial until the bell stops ringing, and then the indicator will be found to point to the name of the locality signalling. For giving alarm of fire in buildings which are chiefly uninhabited, such as warehouses, the thermostat, invented by Mr. R. S. Symington of Glasgow, by which, on any great rise of temperature, a gong is sounded by the electric communication brought about by a rise of a column of mercury, has been found of great value.

The necessity of the London Fire-brigade will be best understood when it is stated that the number of fires had increased from 681 in 1840 to 1946 in 1870, and 2144 in 1883. These returns do not include trifling damages by fire not sufficiently important to require the attendance of firemen, which annually amount to about 2000; nor do they include the calls for chimneys on fire, which annually amount to upwards of 5000. The expansion of the metropolis, of course, accounts in some degree for the greater number of fires, as there are more houses to burn, and as the density of population naturally multiplies the risk of conflagration. But the increase of fires has been in a greater ratio than would be accounted for on these grounds. As a set-off against the large number of fires, it is satisfactory to know that the proportion of serious conflagrations is comparatively small, owing in a

great measure to the increased efficiency of the fire-brigade. A most curious record of fires in London, their causes and their proportion to trades and professions and private houses, has been kept for the fifty years ending 1883, during which time 59,450 fires have occurred, and nearly 70,000 fire alarms have been given at the stations. These statistics show the exact risk of each trade; and although it may appear paradoxical, it is nevertheless a fact that the most hazardous trades are those in which the smallest proportion of fires occur.

Only three fires in 1000 are due to incendiarism, and ninety-eight in 1000 (say a tenth of the whole) are due to something catching fire at a naked candle flame, usually bed curtains,&c. The following are a few of the results obtained:—

		Out of every 1000 Fires.
Airing linen	causes	15
Boiling over of fat	"	15
Candle-flame	"	98
Children playing with fire	"	14
" " with lucifers	"	20
Flues defective or foul	"	70
Incendiarism	"	3
Intoxication	"	2
Hot ashes smouldering	"	26
Upsetting of lamp or candle	"	111

Similar tables give the amount occurring at each hour of the day and night. Eight to nine p.m. is the most fatal hour, giving an average of over 155 fires in London in the year. Nine to ten o'clock yields only about 140, ten to eleven o'clock a little over 100. Then the night fires arise, from fires left smouldering, from candles catching the bed curtains, &c.; and in the hours between twelve and two nearly 240 fires occur on an average in London. The average now sinks rapidly, reaching down as low as thirty between four and five a.m., whence it rises almost evenly to 100 a year between six and seven in the evening, and 110 between seven and eight.

In 1875 Professor Tyndall devised a fireman's "respirator," which has proved very effectual in enabling persons to withstand the dense and poisonous fumes and smoke of large fires. The respirator consists of three layers of cotton wool, the middle one saturated with glycerine; with these are interspersed a layer of charcoal fragments, and the whole is fitted into a cap and hood which completely envelops the head. By means of it anyone can remain in the densest and most suffocating smoke for fully half an hour, where, unprotected thus, he could not exist for one minute.

Fires in the United States.—The exceeding dryness of the atmosphere in the United States produces such an inflammability in buildings, that when a fire breaks out it proceeds with surprising velocity. Owing to this circumstance Americans have organized the most perfect system in the world of extinguishing fires, though all their efforts are often in vain. A stranger in New York or Boston would be astonished at the immense uproar caused by an outbreak of fire. Bells are rung, gongs sounded, and steam fire-engines rush along the streets regardless of everything. It is provided by the city government that "the officers and men, with their teams and apparatus, shall have the right of way while going to a fire, through any street, lane, or alley," &c.; and most unreservedly do the said officers and men make use of this permission. It is quite a point of rivalry among the firemen who shall get the first water on a fire, and the successful one is mentioned always in the report of the engineer.

There are in Boston, which we may take as an example of a well-protected city, about 240 alarm-boxes. These are small iron boxes placed at street corners, on public buildings, and in any convenient and necessary locality. Each box is connected by two wires with the head office at the City Hall, and has its number painted in red, and a notice stating where the key is kept, generally at the nearest suitable house. The authorities usually confide the key to some person whose premises are open all night, such as the proprietor of a hotel, an apothecary, or a doctor. When the box is opened nothing is seen but a small hook at the top, the interior being concealed by another iron lid. Under this second lid is a steel cylinder with pieces of ebony let into its circumference to correspond with the number of the box. This cylinder is connected with one of the two telegraph wires; and a steel spring which presses against it, with the other wire. When the hook is pulled down a clock-work arrangement causes the cylinder to revolve four times; the steel spring consequently passes over the entire surface of the cylinder four times, and contact is broken at the points where the spring touches only the non-conducting ebony. For instance, if the circumference of the cylinder in box 125 could be unrolled it would present an appearance something like this: I II IIIII. Let us now follow the wires to the top of the City Hall, where, night and day, sits an operator watching the recording instrument. Here in a small room are numerous electrical instruments of all sorts, gongs, switches, keys, levers, and wires. In an attic overhead are the batteries. As soon as a box is opened and "pulled" a bell strikes, and a recording instrument in front turns out a slip of paper on which is printed the box number; thus,

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would mean box 125. It prints this four times—the number of revolutions made by the cylinder in the box—to avoid any error.

On the other side of the operator are three clock faces bearing numerals from one to nine, and a pointer. The one to the right is for the units, the middle one for the tens, the one to the left for the hundreds. Under them is a lever working horizontally. Immediately the operator receives the box number he sets these pointers to correspond with it—namely, the left one he puts at 1, the middle at 2, the right one at 5, thus making 125, and then moves the lever underneath.

Now let us see what is the result of this manœuvring. Wires connect these machines with various church bells and gongs in all parts of the city, which ring out the alarm as the operator moves the lever. There are thirty-eight such bells in Boston. When there is a church bell in the neighbourhood, the fire department affixes an electrical hammer to it; if, however, there is no public bell in the right place, a large gong is erected. The machine at the City Hall is automatic when once started, and causes the bells to sound the alarm three times as follows. For box 125 they would strike once; then a pause and strike twice; another pause and strike five times; then a much longer pause. This they repeat twice. For box 218 they strike 2—1—8, always sounding the number three times with intervals between. So quickly is all this managed that in half a minute after a person opens and "pulls" a box he hears the bells begin to respond.

In case the engines which go on the first alarm are not sufficiently numerous to extinguish the fire, a second alarm is given by the operator striking ten blows on the bells, which brings several more engines. If the fire is very serious, a third alarm brings still more engines with hose and ladder companies. This is given by striking twelve blows twice. If the conflagration is becoming very serious indeed, the entire fire department is summoned by striking twelve blows three times. This, of course, very rarely happens. Indeed so efficient are the men and apparatus, that even a second alarm is quite unusual. The second and third alarms are communicated to the City Hall operator by simply "pulling" the same box a second and

third time; or if the pulling apparatus should have been destroyed by the fire, by transmitting a request by a Morse telegraph key, which is placed in every box for the use of the employés when out testing the circuits.

One of the most interesting features in the American fire system is the extreme ingenuity that is exercised to insure the speedy arrival of the brigade at a fire. As has been said, in less than a minute after the alarm-box has been "pulled" the bells are ringing out the alarm all over the city; and—incredible as it may seem—sometimes in *ten seconds* after the alarm is rung, the engines have left their stations with steam up and every one prepared for work. The work of improving the fire department in America is always proceeding. There are in the newspapers almost daily accounts of the trial of new engines, improved ladders, longer fire-escapes, and surer fire-extinguishing compounds, and nothing is spared in checking the tyranny of what has been so aptly termed a "good servant but bad master."

FIRE-CLAY, the name of a clay which occurs in the coal measures, and which, owing to the large proportion of silica it contains and the small quantity of iron, is able to resist great heat. It is nearly free from the alkalies, and is much used in the manufacture of crucibles, of bricks for furnaces, gas retorts, chimney flues subjected to intense heat, and the like. The best kinds of fire-clay are those which can bear the greatest heat without *slagging*. The celebrated Stourbridge clay consists of about 65 parts of silica and 24 of alumina, and about 10 parts of water, with traces of oxide of iron, magnesia, carbon, and water.

FIRE-DAMP or **MARSH-GAS** is known as *light carburetted hydrogen* or *methane*. It is abundantly disengaged in coal-mines from the fresh-cut surface of the coal, being emitted from apertures called by the miners "blowers," in which probably it is contained in a state of compression. It is found in the mud at the bottom of stagnant pools, in which water-plants grow, and when the mud is stirred may be seen rising to the surface in bubbles, in combination with carbonic acid. This terrible scourge of our coal-mines produces its appalling effects by forming an explosive mixture with the air of the mine, thus producing an explosion when by accident or design a naked light is exposed; the result of the explosion is steam and carbonic acid or choke-damp. A serious explosion in a mine, therefore, affords little chance of escape for the unfortunate miners, who are dashed about and maimed or killed by the violence of the shock, then scalded by the steam, and suffocated by the carbonic acid. Fire-damp is very diffusible, and rapidly mixes with the air. Diffusion media have been suggested for its detection. [See LAMP, SAFETY.] It is also found in sewer gas. It is prepared artificially from sodium acetate. See HYDROGEN.

FIRE-ENGINE. In Rome under the emperors there were bands of trained firemen kept. Ctesibius is believed to have invented an engine for the extinction of fires in the time of the Ptolemies; and a few indications of similar inventions are met with in other quarters. But the first fire-engine which has been distinctly described was made by Hautsch of Nürnberg about 1657. Duperrier obtained a patent for making fire-engines for France in 1699. None of these earlier engines had either a flexible hose or an air-chamber; the first was introduced by Jan Vanderheide in 1672, and the latter by Leupold in 1720.

The purpose of the flexible tube is obvious; for it enables the operator to carry the stream of water in any direction from the engine, and the air-chamber secures an equable continuous stream.

Fire-engines first came into general use in England at the commencement of the eighteenth century. Many improvements have, of course, been introduced from time to time; but the principle of construction has remained nearly the same, and is somewhat as follows:—

The engine consists of an oblong chest or cistern, along the lower part of which runs a metallic pipe, into which the water flows from a feed-pipe connected at the other end with the street plug. The water having entered, the interior pipe is elevated and forced into an upright air-vessel by two pumps which are worked by manual power, by means of long handles or levers on the outside. From the air-vessel the water is forced into a pipe connected with the leather hose; and from the latter it is forcibly impelled on the burning buildings. If there were no air-vessel the water would gush forth at intervals at every successive movement of the pump handles; but the stream is rendered continuous by the elastic pressure of air imprisoned within the vessel.

The more recently constructed fire-engines include contrivances for preventing the entrance of mud and gravel, and for getting readily at the valves in case of their being out of order. They are usually drawn by two or four horses, though smaller ones are made to be drawn by hand or by one horse. The hose is of canvas, rubber lined, instead of the leather formerly used. In the United States, cotton is woven into a tube by machinery constructed for the purpose. Two such tubes are fitted one within the other, and held together by a solution of india-rubber, which on consolidating form a water-tight layer. These tubes are only one-tenth the cost of leather, and are said to be even more durable, and to require no oiling.

Those fire-engines of the London Fire-brigade establishment which are worked by hand have usually 6-inch barrels with 8-inch stroke, and throw about 90 gallons of water per minute. Their weight, including implements, firemen, and driver, is about 30 cwt. The pumps are worked by levers, with long horizontal bars attached, to enable a number of men to work together upon the same pumps.

Steam Fire-engines.—During the past few years steam has been most successfully applied to the working of fire-engines in this country and the United States of America. The idea was first brought to a practical issue in 1830, by an English engineer named Braithwaite; but as he received little or no encouragement in Great Britain, he went to the United States, and entered into partnership with an engineer named Ericsson. They speedily obtained a premium offered by the city of New York for the best steam fire-engine; and an impetus having been thus given to the manufacture, several other makers built engines of various kinds, and their employment has gradually so extended that there is now scarcely a town in the United States without them.

In England no others were made till the year 1852, at which time the most powerful engines were the floating ones on the river Thames, belonging to the London Fire-engine establishment. The largest was worked by 120 men, and when well manned was a very effective machine. The great increase, however, in the size of the docks and waterside premises induced the committee in that year to alter this engine by applying steam to work it instead of manual labour, which at once doubled the power of the engines. The alteration so completely proved the advantage of steam over manual power that in 1855 an entirely new floating steam fire-engine was constructed by Messrs. Shand and Mason, the makers to the London Fire-brigade. Two others, of immense power, were made in 1868. Each of them is capable of throwing nearly 24 tons of water a minute, and they are so arranged that they can either throw their water through one hose in a gigantic column, enough almost to drown a village, or they can supply with an enormous water-pressure no less than thirty-two fire hose of the common size. These engines may, in fact, be looked on as being in themselves complete fire-brigades, for each is equal to thirty-two hand-worked engines of the ordinary capacity. These engines propel the boat and

work the fire-engines, as required. In 1858 Messrs. Shand and Mason made the first land steam fire-engine in England since that of Mr. Braithwaite. This was publicly tried at the Grand Surrey Canal, and afterwards sent to Russia. In 1860 they supplied the first land steam fire-engine of the London establishment, and it so unquestionably proved its superiority over the old method that at least one such is now kept at all the principal stations of the metropolis. Steam fire-engines have also been introduced into some of the large provincial towns. They are, of course, of great power, and equal to three of the most powerful hand-worked engines. They are about three times as expensive to build, but last three times as long, and of course are not nearly so costly to work. A few pounds of coal, in fact, triple the amount of service done by the paid labour of thirty men. At the burning of the Pantechnicon in 1874 it was computed that ten steam fire-engines poured as much water as could have been projected by a hundred manual engines. It used to require from twelve to fifteen minutes to get up steam in the boilers of these engines, but by a very simple arrangement this source of delay is quite obviated now. The fires are all ready laid in the furnaces, though not lighted, but a gas jet from a flexible tube is kept playing on the boiler from the firebox, and the water inside is always kept at such a point as to give a pressure of a few pounds of steam. After this, to get up full power by lighting the furnaces is only a matter of from two to three minutes, just the time allowed for the engine to be horsed, manned, and ready to start from the first instant of receiving the alarm. But superior as steam fire-engines are to those worked by hand, the latter can never be altogether abandoned, for the reason that a hand-worked engine with its firemen and two horses can, and often does, travel to fires at the rate of 12 or 14 miles an hour, a pace scarcely possible for the much heavier steam-worked engines. The hand-worked engines, therefore, are instantly despatched on receipt of an alarm, as the *avant-coureurs* of those worked by steam.

In the steam-engine in general use by the London Fire-brigade the boiler is of the upright tubular construction, and is placed in front of the hind axle. The steam-engine and pump are direct-acting, and being placed vertically at the back of the boiler, divide the machine into two distinct parts—the front comprising the hose, implements, &c., with seat for firemen; and the back, the engine complete, with footboard for engineer. Steam of a working pressure can be raised from cold water in ten minutes, and the full power can be sustained for any length of time, and deliver about 200 gallons per minute to a height of from 150 to 200 feet.

Merryweather—the other important English maker—has constructed an improved steam fire-engine capable of throwing a massive stream of water 1¾ inch in diameter to the extraordinary height of about 200 feet. The main features that seem to have made this style of engine successful in practice and in the various competitions that have taken place since the introduction of steam fire-engines both in England and abroad, are the simple and powerful boiler, and the large stroke of the pumps which are employed, so that the rapid motion which is detrimental to all pumping machinery is avoided. Steam can be got up very quickly. In one instance at a public trial a pressure of 60 lbs. per square inch was obtained in six minutes, and 100 lbs. in seven and a half minutes from the time of lighting the fire, cold water only being supplied to the boiler.

Chemical Fire-engines.—Many soluble salts have been tried to increase the efficacy of the water thrown by a manual engine. An engine, first used in France, and more recently introduced into this country, called "L'Extincteur," contains carbonate of soda and tartaric acid in separate compartments; carbonic acid gas, generated from these materials, mixes with the jet of water thrown against the burning mass, and is very successful if the fire be not too large.

The principle has also been applied to larger engines, the pressure of the generated gases having been made use of with good results as a propelling power. In his work on "Protection against Fire" (London, 1873), Mr. Joseph Bird, a gentleman of great experience in the American fire-brigade, pointed out the immense utility of small hand-engines. The time which elapses before the arrival of a fire-brigade engine, short as it may be, often gives the flames a complete mastery. Small hand-engines, such as are sometimes used in the watering of gardens, &c., were introduced into the London fire-brigade in 1848, and a vast number of minor fires are still effectually extinguished by them. No performance can take place in any theatre in Paris unless there is on the stage a small fire-engine and two firemen; and there is no doubt that by a few simple precautions a vast percentage of fires might annually be prevented, while repeated disasters enforce the lesson of how little dependence can be placed on any so-called fire-proof buildings.

FIRE-ESCAPE. The Royal Society for the Protection of Life from Fire was established in London in 1836. Its original objects were—to provide as many fire-escapes and competent men as the funds would allow, to instruct others in the use of such machines, to examine into the merits of any newly-invented fire-escapes, to diffuse information respecting the best means of protecting lives in danger from fire, and to reward persons who assist in saving lives so endangered. The funds for the support of the society were subscribed by private individuals, public companies, and the corporation of London; but all these contributions were purely voluntary. From the establishment of the society to 1868 not less than 9299 fires had been attended by its escapes, and 1150 lives rescued from death by fire or suffocation; and all this was done without aid from government or Parliament, county-rate, or any kind of endowment fund or vested charity. By the Metropolitan Fire-brigade Act, 1865, the management of the Fire-brigade was transferred to the Metropolitan Board of Works, and the committee of the Fire-escape Society feeling that the time had arrived when the management of the fire-escapes within the metropolitan area should be under the same control as the fire-engines, the escapes were handed over to the Metropolitan Board of Works; and are now attended to by the men of the London FIRE-BRIGADE. For a time the society continued to supply fire-escapes both for London and the provinces, but ceased to do so in 1881, when a scheme was established by the Charity Commissioners providing for the appointment of trustees for the future regulation of the charity, and for the administration of the annual income derived from invested funds. The income is now applied in promoting the protection of life from fire by the grant of rewards for saving life from fire to persons who shall have distinguished themselves or received injury while engaged in the rescue of life from fire, either by the gift of medals, testimonials, or sums of money, or by the grant of money to the parents, widows, or children of such persons whose deaths may have resulted from their endeavours to save life from fire.

A large number of ingenious machines have been invented to enable persons to escape from burning buildings, but the contrivance which, after much consideration, has been found most effective, is in the following form:—There is a main ladder, from 30 to 35 feet long. An upper ladder folds over this main portion, and is easily raised into its proper position by lever-irons or by pulleys. Under the whole length of the main ladder is a copper-wire trough or net, affording sufficient space for a person's descent. The main ladder is supported upon a peculiar wheel carriage, which facilitates its speedy transfer from

place to place, and enables it to be adjusted at any convenient angle against the walls of a burning house. The entire height reached by the main and upper ladders is usually 50 feet; but most of the fire-escapes now carry a short supplemental portion, which on emergency can quickly be fitted into the upper ladder, and raise the total height to 60 feet. A short ladder, for reaching the first-floor windows only, is conveniently carried under the carriage of the escape; and this, sometimes aided by the upper ladder, is useful in cases where the large escape could not be readily applied. The number of fire-escapes in London in 1884 was 147.

FIRE-FLY is a name applicable to all winged luminous insects. The power of emitting light in the dark is confined among insects to two families of beetles, Lampyridæ and Elateridæ. The luminosity of the LANTERN-FLY (Fulgora) is now denied. To the first of these families belongs the common GLOWWORM (*Lampyris noctiluca*), found in many of the southern counties of England. The female of this insect is wingless and larviform, and emits a far more brilliant light than the male. In other tropical species of the same genus both male and female have wings. The luminosity is due to the concentration of phosphorescent granules in the hinder part of the abdomen. According to Matteuci, the phosphorescent substance, which by daylight has a pale yellow appearance, burns by means of the oxygen in the surrounding tracheæ without any indication of the presence of phosphorus. All the species of the family Lampyridæ are nocturnal in their habits, and the brilliant light serves to conduct the sexes to each other. From observations made by the Rev. H. S. Gorham, it appears that the eyes of the Lampyridæ are developed in inverse proportion to the brilliancy of the light emitted, and where both the eyes and luminosity are feebly developed the antennæ are complicated in structure. The species of this family are very numerous, being particularly abundant in America.

Southey in his "Madoc" thus poetically alludes to the fire-flies of South America:—

> "Sorrowing we beheld
> The night come on; but soon did night display
> More wonders than it veiled; innumerous tribes
> From the wood-cover swarmed, and darkness made
> Their beauties visible; one while they streamed
> A bright blue radiance upon flowers which closed
> Their gorgeous colours from the eye of day;
> Now, motionless and dark, eluded search,
> Self-shrouded; and anon, starring the sky,
> Rose like a shower of fire."

The fire-flies of the poet are probably to be referred to the family Elateridæ, one genus in particular, Pyrophorus, being remarkable for this property. The light in this family is emitted from two tubercles on the prothorax which protect vesicles of phosphorescent substance similar to that found in the Lampyridæ. The light emitted by some species of Pyrophorus, notably *Pyrophorus noctilucus*, is very brilliant. They abound in South America and the West Indies. They are sometimes employed as living lamps for household purposes; in some parts of South America the ladies use them for adorning their hair or their robes by inclosing them alive within a thin gauze work. Prescott, the historian of the conquest of Mexico, records the terror with which they inspired the Spanish in 1520:—"The air was filled with 'cocuyos,' a species of large beetle, which emits an intense phosphoric light from its body, strong enough to enable one to read by it. These wandering fires, seen in the darkness of the night, were converted by the besieged into an army with matchlocks."

FIRE-INSURANCE. See INSURANCE.

FIREN'ZE. See FLORENCE.

FIRE-PROOF BUILDINGS. It has not yet been found practicable to construct a building that shall be proof against all risk of conflagration, but many methods have been devised to render houses and other buildings less liable to take fire. Much evil is done by the ordinary use of the word fire-proof, as the injury likely to be caused by a conflagration depends much more on the contents of a building than upon the building itself. Thus a building which would be perfectly fire-proof as an office or a private dwelling, might be most dangerous and inflammable if converted into a factory or warehouse. A building to be truly fire-proof should be divided into compartments, and so constructed that the contents of any one compartment might be consumed by fire without calcining, melting, or otherwise destroying the surrounding horizontal and upright partitions, and therefore without communicating fire to the other rooms or floors. No fire could then destroy a greater quantity of property than the contents of one compartment. It was long thought that the nearest approximation to fire-proof construction may be obtained by the walls being built of stone or brick, the tiles and lintels of iron, the staircases of iron and stone, and the floors or landings of tiles, concrete, or stone; but Captain Shaw, chief officer of the London Fire-brigade, a good authority on the subject, in one of his reports showed that "stone is in no sense fire-proof; on the contrary, it yields to fire sooner than almost any other building material, and much more rapidly than wood. It is true that it does not, like wood, add fuel to the fire, but it does worse, as its known tendency to split off from the walls, and fall down altogether, prevents the firemen from availing themselves of the best positions for their work, which they can almost always occupy where there are wooden staircases." Iron also is liable to bend and twist, and even by expansion to break up the materials in which it is set, at comparatively low temperatures, and it melts when subjected to a temperature even below that of the centre of a large building on fire. Good oak posts with girders and joists, well filled in with proper concrete prepared for the purpose, are perhaps more fire-proof than any arrangement of iron combined with brick or stone. The experiments of Captain Shaw, carried out after the Pantechnicon fire in 1874, showed, in fact, that even inflammable pitch-pine posts, 12 inches thick, were absolutely and perfectly proof against any heat which was likely to be applied to them.

The great use of timber in building renders very important any method by which it may be rendered incombustible. Solutions of muriate of ammonia, muriate of soda, sal-ammoniac, borax, alum, and several other salts and alkalies, with which wood may be impregnated, or which may be applied to its surface, possess this quality in a limited degree. The non-conducting power of earth and sand, or of a layer of sand placed over timber, has been the basis of many plans for preventing fires.

Whether, however, ordinary buildings of importance may or may not be rendered fire-proof, there is such a vast accumulation of wealth and of its representatives in our great cities, that an absolute necessity exists for a place of deposit for valuables which shall be secure at once from both fire and burglars. To meet this demand, a building of very extraordinary construction was finished and opened in the heart of the city of London in 1876 by the National Safe-deposit Company. The outside appearance is simply that of any strongly-built banking or insurance office. The strength of the building is concentrated in an underground "citadel" or "fortress," with an interior core, 70 feet by 32, and 36 feet deep. The side walls of the citadel are 6 feet thick, and built of the hardest bricks that could be made; they are backed by a mass of concrete almost as thick, and lined with armour-plates that would suffice for many of the queen's ironclads. The doors are massive slabs of the toughest rolled iron, 12 inches in thickness, which are made to slide by hydraulic agency instead of turning on hinges, while their enormous weight (4 tons each) renders locks and bolts unnecessary. There are

thirty-two of these doors; and a skilled workman, employed to do his best in drilling one of them, was only able in fourteen hours' work to penetrate 1 inch of the iron, after breaking or blunting eighty-six drilling-tools. One can hardly imagine the process of surreptitious drilling that would penetrate either these doors or the 12 feet of massive brick and concrete wall; nor is it easy to see how fire could work much destruction. If any riot or tumultuous attack occurred, access to the citadel would be no easy matter, seeing that the roof is formed of bomb-proof semicircular arches. Even the subterranean operation which military engineers call mining is provided against, for the whole citadel is surrounded by water, which would frustrate, if not drown, any invaders.

The space within the citadel is divided into four floors or storeys, each of about 9000 square feet, and is fitted with more than 10,000 safes and chests of various sizes. Such buildings have been constructed for many years in the United States, but the one described is the first of its kind in the United Kingdom.

FIRE-PROOF SAFES are chambers or boxes specially constructed to resist the action of fire, and generally also made with a view to baffle the attempts of burglars. It was not till 1834 that the fire-proof principle was applied to safes, but since then much ingenuity has been brought to bear on the manufacture of them. Modern fire-proof safes generally have double walls, which contain a sort of lining of fire-proof composition, for the purpose of arresting the progress inwards of the heat. Of course no safe could resist an unlimited heat for an unlimited time; but of late years makers have been successful in manufacturing safes which will preserve their contents unharmed during the worst conflagrations likely to occur. The lining is sometimes an absorbent substance, such as sand or sawdust, and small vessels containing some kinds of liquid; the heat from an external fire, acting on the liquid through the iron, bursts the vessels, saturates the absorbent substance, and greatly retards the heating of the interior. In the best safes a salt, such as alum, is used as lining, which when heated parts with its water of crystallization. This, escaping as steam, keeps down the temperature for a considerable time, generally long enough to outlast the fire. Some of the safes are painted on the inside with a peculiar composition, to prevent the metal being oxidized or corroded by the action of acids employed to produce the moisture; and the exterior of the iron is case-hardened, or rendered like steel, to enable it to resist the action of drilling instruments. It may be repeated that no safe can be made *fire-proof* in the sense that it can hold out against any intensity or continuance of heat. Most of the best makers are content to call their productions fire-resisting, a title which fairly describes the capability of their manufactures.

FIRE-SHIP is a vessel laden with combustible materials, which is sent in a burning state among the ships of a hostile fleet for the purpose of setting them on fire. Such vessels have been used in various countries at different times. The Chinese tried them against the British fleet before Canton in 1857, but without success.

FIRE-STONE is the name given to any stone of such a composition that it is capable of withstanding heat and sudden changes of temperature without injury. The term is often applied in descriptive geology to some particular bed which has a local reputation as a fire-resisting material, one of the most familiar examples being "the fire-stones of Surrey" or "malm-rock." This is a lithological variety of the CHLORITIC SERIES (Upper Greensand). It consists of a calcareo-arenaceous bed that appears along the escarpment to the north-west and west of the Weald, as for instance at the foot of the chalk hills running from Bletchingley to Merstham, and from Westerham to Petersfield, to the south and east of which its lithological character alters and it loses its essential peculiarity.

FIRE-WORSHIP. At the present day the chief fire-worshippers are the Parsees, who are so reverent of the sacred element that they even decline to smoke tobacco. The god of the universe, as taught by Zoroaster, being regarded as the fountain of light, is most aptly symbolized by the sun, or, failing that, the moon or stars; in any case the believer is enjoined to face some luminous object during his prayers. Five sorts of fires are therefore kept up in Persian temples, and the priests only approach them with sacred instruments, and with the mouth masked, lest the fire be defiled by the breath. It must be borne in mind, however, that to call the Parsees fire-worshippers is rather to stretch the term, since the fire is purely a symbol of the Deity to them, and no more divine in itself than are the candles on the altar of a Roman Catholic church.

But in our own country in the earliest ages fire-worship was a reality. The ceremonies of the BELTEIN fire undoubtedly point to the worship of Baal as god of fire. Those who drew scorched pieces of the cake baked in the bonfire on May Day had to leap thrice through the flames, and this superstition lasted in the Highlands to within the memory of man. The Druids used to offer hecatombs of prisoners to the fire-god, burning them in wicker baskets, that they might get good crops. The Romans were not a thin-skinned people, but this ghastly savagery revolted even them (see in Strabo).

The fire of St. Bridget at Kildare in Ireland remained alight till her monastery was suppressed under Henry VIII., except for a short time of accidental eclipse in the thirteenth century. When she took the veil the house she lived in blazed with a flame which reached to heaven, and this flame lit the altar and burnt for ever. Each of the nineteen nuns watched the fire one night, and on the twentieth evening the superior cried, "Bridget, watch your own fire, this night belongs to you." (Giraldus Cambrensis.) As with the Parsees, the nuns were not allowed to blow on the fire. No male person dare approach the shrine nearer than the encircling hedge, a prohibition which recalls the everlasting fire of Vesta at Rome. The whole group of legends of St. Bridget is manifestly of pagan origin, and the goddess they sprang from was one of that ancient Irish Olympus the "Jupiter" of which was the god of heat or fire, *Dagda*, "the great good fire." His son was Luga (flame), his daughter Brighid (the fiery). The moon (Aine) was the queen of heaven, and her worship lasted long. Thus Camden says, "I cannot tell whether the wilder sort of the Irishry yield divine honour unto the Moone; for when they see her first after the change, commonly they bow the knee and say over the Lord's prayer, and so soon as they have made an end they speake to the Moone with a loud voice in this manner, 'Leave us whole and sound as thou hast found us.'" To this day the Irish peasant visiting a healing spring walks round it thrice in the direction of the sun's motion, and up till lately a burning brand was carried thrice daily round a child till it was safely christened.

In Scotland, till after the present century had begun, fire-worship continued as a rite to cure a murrain among cattle, and no common fire would do. The special fire was differently produced. In Mull they used a wheel turning in the line of the sun's course over nine spindles of oakwood to kindle the pure flame by friction. In Caithness a wooden auger was worked up and down in a groove on the floor of a hut; in the Western Islands eighty-one married men worked two planks together, nine at a time. All other fires were extinguished and relighted from the new element. At Burghead, on the southern shore of the Moray Frith, about 9 miles from the town of Elgin, the "clavie" is burnt every year on New-year's Eve (old style). The clavie is half an empty tar barrel, nailed on to a stout pole some 4 feet in length, by a nail which is given by the blacksmith and may not be bought, and which

is driven home with a stone, not a hammer. The barrel is filled with combustibles, and tar is poured over the whole; room is left for a burning peat, for the fire must be kindled in no other way. When it is well alight one of the fisher folk seizes the clavie and runs, the tar dripping down him, to the first cross road, when he is relieved; and so all take it in turn. The clavie is supposed to be carried round every vessel in harbour, while a handful of grain is thrown into it to insure plenty for the coming year, but this ceremony is now shortened. The course of the clavie is to a certain pillar, probably an ancient altar, on the hill called the Dooric, on the northern promontory of the harbour. Arrived here it is allowed to blaze for half an hour and is then broken up, still flaming, and the burning brands are scrambled for by the fishermen, those who get one being esteemed lucky for the year. That this in its origin is a sacrifice to a fire-god no one can doubt.

Pennant ("Tour in Scotland, 1772") has preserved to us a piece of fire-worship then existing in Highland villages, and performed on the 1st of May. Among many other ceremonies an oatcake was baked at the sacred fire, and the sacrificer, taking the cake in his hand, broke off pieces and threw them into the fire over his shoulder, saying, "This I give thee, preserve thou my horses; this to thee, preserve thou my sheep," &c.

FIRMAN' or **FIRMAUN'** is the name of the decrees issued by the Turkish sultan, which are signed with his own cipher or signet. Firman is also the name of a kind of passport which the pashas are in the habit of granting to travellers, especially Europeans, by which they enjoin the subordinate authorities to give the bearer protection and assistance.

FIRO'LIDÆ is a family of molluscs belonging to the HETEROPODA, an order of GASTEROPODA. The Heteropoda are free-swimming marine forms; in accordance with these habits the shell and the broad creeping disc forming the foot of the typical gasteropods are peculiarly modified. In the family Firolidæ the mid part (mesopodium) of the foot is compressed laterally so as to form a vertical fin projecting from the ventral surface; the rest of the foot before and after this fin is so reduced as to be confluent with the ventral surface. At the edge of the mesopodium is in many species a disc-like sucker. The posterior region of the body aids in locomotion, forming a powerful caudal fin. The visceral hump is much reduced, and the shell is sometimes entirely absent. The branchiæ are plume-like tufts, situated on the hinder part of the back, directed forwards; and immediately behind them are the heart, liver, and other viscera. The body is gelatinous and transparent, with a muscular investment, elongated, and generally terminating in a compressed tail. In swimming the body is reversed, the paddle-like foot being uppermost. These animals are capable of distending their bodies with water.

In the genus Carinaria the branchiæ, the heart, liver, and other organs are protected by a delicate transparent shell, somewhat resembling that of the Paper Nautilus, and known to collectors under the name of Venus' Slipper and Glass Nautilus. This shell is no protection to the body generally, being too small for the reception of the animal. The general form is subcylindrical and elongated. The whole mass is transparent and dotted with elevated points. The foot is thin, paddle-like, reddish, beautifully reticulated by muscular fibres crossing each other, and furnished with a sort of sucker, by means of which the animal is enabled to adhere to rocks or stones while reposing at the bottom of the sea. The course of the œsophagus, stomach, and alimentary canal is easily seen through the transparent parietes of the body. The sexes are distinct. Eight species are known from the Mediterranean and the Atlantic and Pacific Oceans. They are met with near the surface of the sea, and swim with great rapidity. They feed on small marine Hydrozoa and probably on Pteropods. The genus Cardiopoda resembles Carinaria, except in having a small cartilaginous shell. In the genus Firola (or Pterotrachea) the body is slug-like, the shell is absent, and the visceral hump is scarcely perceptible. Fourteen species have been described with a similar distribution to Carinaria.

FIROZPUR', a district in the Punjab, British India, forming the southern district of the Lahore division. It has an area of 2739 square miles, and a population of 550,000. It consists of an unbroken plain, comprising every variety of soil, from the most fertile to the most barren. The chief town is Firozpur, situated on the old high bank of the Sutlej, 3½ miles from the present bed of the river. It is the seat of a thriving commerce, due chiefly to the exertions of Sir Henry Lawrence, who induced many native traders to settle in the city, and to the erection of a large cotton press in the vicinity by an English merchant. The main streets are wide and well paved, while a circular road which girdles the wall is lined with the gardens of the wealthy residents. The arsenal, to which the town owes its importance, is by far the largest in the Punjab, and is well stored with munitions of war. Population of the town, 20,000.

FIROZSHAH', a battlefield in the Firozpur district of the Punjab, about 12 miles from the left bank of the Sutlej. It is rendered famous by the attack made upon the formidably intrenched Sikh camp, on 21st December, 1845, by the British forces under Sir Hugh Gough and Sir Henry Hardinge. After two days' severe fighting the intrenchments were carried and the enemy completely routed, but not without heavy losses on the part of the conquerors. No trace of the earthworks now remains, but a monument erected upon the spot perpetuates the memory of the officers and men who fell in the engagement.

FIRST-FRUITS. This was a very ancient papal tax of the whole of the first year's income, applied to those greater ecclesiastical benefices to which the popes had always claimed the right to institute. Attempts were made to extend first-fruits to every benefice whatever, but these were steadily resisted. The continued encroachments of the popes indeed brought about their own defeat; for in France the Pragmatic Sanction of 1438, which was made under Charles VII. as embodying the views sought to be maintained at the Council of Basel, fully declared the liberties of the Gallican Church, and among other papal abuses swept away this of the first-fruits. Spain threw off first-fruits about 1500, Germany followed suit in 1521, but England had a different fate. Henry VIII. by no means abolished first-fruits; he only changed their destination. Having assumed the position of head of the English Church, he took all papal rights as his own, this among others. First-fruits continued to be paid to our monarchs till the time of Queen Anne, who out of this and other such imposts founded the Queen Anne's Bounty [see BOUNTY] for the assistance of the poorer clergy. The tax is levied with great firmness, but of course with perfect impartiality. At Dr. Benson's election to the archbishopric of Canterbury in 1883, for instance, his fees amounted in all to £885 5*s.* 6*d.*; and of this the modified payment which now stands as representing the first year's benefice amounted to over a fourth (£281 5*s.* 6*d.*) The first-fruits were given up in Ireland in the third year of William IV.

FIRTH. See FRITH.

FISC, FISCUS, means a basket of wicker-work, such as would hold a sum of coined money. Under the Roman Empire it was used to signify the treasury of the emperor as distinguished from that of the state, and it has received the same meaning in some modern states. The fiscus was chiefly replenished by fines and unclaimed property of deceased persons; the taxes and other revenues were paid into the *ærarium.* Under absolute monarchs, however,

the two treasuries have been often confounded both in name and in reality. Under the feudal system *fiscus regius* and *fiscales terræ* signified the domains of the crown, and the peasants attached to those domains were called *fiscalini*. Fiscus by degrees came to be used figuratively for the rights of the crown in civil as well as criminal matters, and the king's attorney was called *procurator fisci*, *procureur fiscal* in French, *avocato fiscale* in Italian.

FISHER, JOHN, Bishop of Rochester, was born at Beverley some time between 1459 and 1465, and educated at the collegiate school of his native place. He thence removed to Michael House College, Cambridge, of which he became master in 1495. Margaret, countess of Richmond, Henry VII.'s mother, appointed him her chaplain and confessor. He was named the first Lady Margaret's professor of divinity in the University of Cambridge, and became bishop of Rochester in 1504. In 1527 Fisher was the only bishop who refused his signature to the declaration that the marriage of Henry VIII. with Catharine was unlawful. In 1534 Fisher again stood alone on the question of the pope's supremacy. These opinions created much ill-feeling against him among the partisans of Henry, and on the exposure of the imposture of Elizabeth Barton, the nun of Kent, it was deemed fit that those who had been privy to the deception should not escape unpunished. Among these Fisher was accused. He had been drawn into a correspondence, and on this pretext, with very little examination, was committed to prison, but released on the payment of a fine of £300. For his continued denial of the king's supremacy he was called to account on the 17th of June, 1535. The lord chancellor, the Duke of Suffolk, and some other lords, together with the judges, were appointed commissioners for his trial. He was found guilty, and condemned to die as a traitor. On 22nd June he was beheaded.

FISHERIES, localities frequented at certain seasons by great numbers of fish, where they are taken upon a large scale. Some fisheries are carried on in rivers or their estuaries, others in bays or along the coasts, and some far out at sea on what are known as deep-sea fishing-grounds. Fish has been used for food from the earliest times, and as the demand has always more than equalled the supply the importance of fisheries can hardly be over-estimated. It is supposed that the fisheries of Great Britain are the most important in the world, and it is difficult without careful investigation to estimate their value to the nation. In the United Kingdom there are about 120,000 persons who are employed constantly or occasionally in fishing, who with their dependants may be taken as 400,000 of the inhabitants. It has been estimated that at least 550,000 tons of fish are annually taken in British waters by British fishermen, and though the value of this quantity is somewhat difficult to estimate it is certainly not less than £11,000,000 sterling, and it may be considerably more. The principal fisheries of Great Britain are those connected with the capture of salmon, herring, pilchard, haddock, mackerel, cod, soles, eels, turbot, shellfish, as oysters and others.

The principal methods employed in the capture of sea fish are the trawl net, the drift net, the seine and stow nets, and the use of the hook and line. *Trawling*, or as it is more generally called *beam trawling*, consists in towing and trailing a large flattened bag net over the bottom of the sea in such a manner as to catch those fish who live near the bottom. The net is triangular in shape, from 36 to 50 feet wide at the mouth, and often 100 feet long. The mouth of the net is kept open and extended by means of a beam of wood, to which the upper side is fastened, and which is supported at a height of nearly 8 feet from the ground by means of two iron frames, called the trawl-heads, made in the shape of the letter D, one at each end, which slide along the ground as the beam is drawn forward. The lower part of the mouth of the net is fastened along a hawser called the ground rope, and drags along the bottom. The fish, disturbed by the beam, in trying to escape pass into the net, and by an ingenious series of contrivances in its interior are prevented from passing out again until the net is drawn up over the side of the boat. The trawl is towed over the ground by a stout rope about 150 fathoms in length fastened to two shorter ropes coming from each end of the beam, so as to give a fair pull to the net. To use the trawl to the best advantage considerable knowledge and skill are required, and its various details require careful management and the observance of numerous precautions. It cannot be used where the bottom is rocky and uneven, and it must always be towed in such relation to the tide as will keep it properly expanded. It is, however, one of the most profitable of the various methods employed, and it has been developed enormously during recent years. This is especially the case in respect to the North Sea fisheries, where a large extent of suitable ground is always available. The centre of this fishery is the Great Doggerbank, which lies between the coasts of Great Britain and those of Norway, Denmark, and Holland. It is about 300 miles long by 70 miles wide, having an area in round numbers of some 20,000 square miles. During the season a fleet of large trawlers are constantly employed in working its fishing-grounds, and the services of fast steam "carriers" are called into requisition to collect the fish taken and hasten with it to the nearest market from which it can be despatched to the large centres of population. It is from this vast field that the principal towns are supplied with turbot, soles, and brill, included with others in the technical term "prime," and also with plaice, haddocks, whiting, &c., which are known in the trade as "offal." Other important trawling stations are found at Plymouth, Brixham, Great Yarmouth, Lowestoft, Tenby, and the sea between the Isle of Man and the English coast.

The *drift-net* fishing, which ranks next in importance to trawling, is carried on in an entirely different manner, the principal fish caught in this way being herrings, mackerel, and pilchards. Drift nets are so called because they are neither fixed nor towed within any particular limit, but having been shot are allowed to drift with the tide. As the trawl is designed for such fish as swim near the bottom, so the drift net is planned for the capture of fish who swim in shoals nearer the surface. Its principle is that it shall have meshes of such a size as will best entangle the fish for which it is designed, allowing the head but not the body to pass, retreat being made impossible by the expansion of the gills when the head is once through. It hangs for a great length, like a perpendicular wall in the water: the upper edge fastened by short ropes to a stout cable supported by means of buoys upon the surface, the edge being also corked at intervals, while the lower part is kept down by means of sinkers or weights. In fishing a large number of these nets are fastened together end to end, the line extending in the case of the larger vessels to a length of 1¼ mile or even more. It is carried on mostly at night, the nets being got into the water as darkness sets in, and hauled in again towards morning. By this means enormous quantities of fish are taken, and during the season thousands of miles of nets are spread out every night round the British coasts. To the counties bordering upon the English Channel and upon the North Sea drift-net fishing forms a most important industry, and in Scotland the drift-net herring fishery is looked forward to as the most valuable harvest. There upwards of 1,000,000 barrels of herrings have been taken and cured in a single year, and this without taking into consideration such as were sold locally and eaten fresh. Taking the average of the last five years the annual value of Scotch herrings, fresh and cured, is equal to £3,000,000 sterling. Thousands of tons of mackerel

are also taken every year by means of drift-net fishing off the British coasts, while the pilchard fisheries of Cornwall and Devon are also of the greatest importance and value to these counties.

The *seine net* is also very largely used for the capture of pilchards, the chief station being at St. Ives Bay on the north coast of Cornwall. At certain seasons of the year large shoals of these fish set in towards the shore, and immense nets, from 160 to 200 fathoms long, are employed to inclose them and draw them in to the shore.

The *stow net* is used in the waters of the Solent, the Wash, and the mouth of the Thames for the capture of sprats and young herrings. It consists of a gigantic funnel-shaped bag, 180 feet in length, tapering from its square mouth, 31 feet high and 21 wide, to a diameter of 2 or 3 feet at the smaller end. This is suspended under the bottom of the fishing boat, which is anchored at a favourable place at the first of the tide, and the fish are swept in by the current, and once in are by the same force prevented from escaping. A stow net of peculiar construction, but worked upon similar principles, is used in the Thames for the capture of whitebait. The Thames shrimps are caught by means of a small beam trawl net, provided with a second beam instead of a ground rope.

Hook-and-line fishing, for the capture of cod, ling, haddock, whiting, &c., is carried on all round the British Isles, and also on the great fishing-grounds of the North Sea, already described. There are two kinds of hook-and-line fishing practised by British fishermen, one with short lines held in the hand of the fisherman who uses them, and which are therefore called "hand lines;" and the other with what are termed "long lines," which are paid out from a fishing boat, and hauled in after a suitable interval. The hand lines are generally employed by boats fishing within a moderate distance of the shore, the longer lines being used in the deep-sea fisheries. In the long-line fishing for cod a complete set of lines consists of 180, of 40 fathoms length each; and as each line spreads twenty-six shorter lines, nearly 5000 hooks are spread out for one fishing. These lines, which stretch a distance of nearly 8 miles, are laid across the tide, and are steadied by means of small "anchors" placed at every 40 fathoms. At either end of the line, and at every mile of its length, it is attached to conical, hooped, flag-bearing buoys, called "dans," which serve to indicate its position to the fishermen. The hooks are baited with whelks, and the fish when taken are either preserved alive in a well in the boat, or are packed in ice for the market. Hooked fish command a higher price than those caught in the trawl, as they are less knocked about in the catching. Many of the boats which fish for cod off the Doggerbank bring their takes alive into Grimsby, and the fish are there preserved by means of wooden chests about 7 feet in length by 4 feet in width and 2 in depth. Such fish will live for a fortnight in the Grimsby fish dock, and when wanted for market they are taken out and killed by a blow on the head. Sometimes nearly 20,000 fish are preserved at one time in this way at Grimsby alone, and at Harwich large quantities are stored in a similar manner. Such fish are known in the market as "live cod."

The importance of the fisheries of Great Britain has caused many laws to be passed from time to time for the purpose of protecting the breeding of certain fish, of advancing public money for the encouragement of fisheries, and for the securing of regular supplies of fresh fish. Commissioners have been appointed to watch over the various fisheries, and to report annually upon the same to the government.

Formerly there were various Acts in existence for the regulation of our fisheries, limiting the size of fish brought into market. These have mostly been repealed, and to this policy some attribute a marked deterioration in size and quality of many species. There has existed among fishermen for many years an opinion that the more efficient modern methods of fishing, especially extensive trawling, has acted injuriously on the supply of fish; but that the quantity of fish in the seas has decreased does not seem to be borne out by facts. It has been proved that most of the old fishing-grounds actually yield a much larger quantity of fish at the present day to what they did in former times, while the supply available is practically inexhaustible. Many naturalists have drawn attention to the amazing powers of reproduction possessed by the finny tribes, and in the face of their statistics the quantity annually taken seems altogether insignificant. As illustrating this power it may be mentioned that the female herring lays from 20,000 to 30,000 eggs, and the eggs in a moderate-sized cod have been found to amount to over 4,000,000. Professor Huxley has estimated that in the shoals of cod which appear off the coast of Norway in the months of January and February there are about 120,000,000 to each square mile, and that this number would require 840,000,000 herrings for a week's supply of food. He considers that the fishing operations of all nations of the earth do not result in the catching of 5 per cent. of the food-fish which are the objects of the great sea fisheries, such as cod, herrings, mackerels, pilchards, &c.

It is probable that while the increased cost of better boats has increased the risk of engaging in the trade, the use of them has altogether destroyed the profits of the old-fashioned small craft. The discharge of sewage and of various kinds of poisonous refuse from mines, manufactories, &c., into the sea, have a distinct effect upon the lower animals on which fish largely feed; and with the destruction of their food inshore the fish naturally go further off to seek for it. There are already Acts of Parliament regulating the oyster, salmon, and some fresh-water fisheries, and with proper care the enforcement of restrictions on the capture and sale of undersized and unseasonable fish would be very easy.

FISHES (Lat. *pisces*) form one of the great classes of the sub-kingdom VERTEBRATA. A fish may be defined as a vertebrate animal breathing throughout life through the medium of water by means of branchiæ or gills, having one auricle and one ventricle to the heart, cold red blood, and extremities formed for swimming.

A typical fish shows clearly in its structure its power of rapid and steady motion through the water which forms its home. The body is of an elongate-oval compressed form, covered with scales directed backwards, and furnished with fins. Such is the external appearance of many of the best-known fishes, such as the perch, mackerel, and cod. But in no great group of the Vertebrata is the

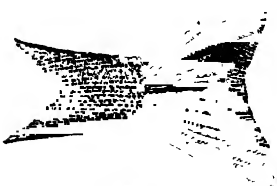
Three-spotted Cheironectes.

external form more yielding to the influence of habits of life and dwelling-place than in fishes. The long snake-like eels, the flat compressed flat-fishes, the rounded sun-fishes and globe-fishes, the grotesque anglers (an allied form is figured above), the pipe-fishes and the sea-horses, the skates and the sharks, are all instances of the extreme variety of external form in this group.

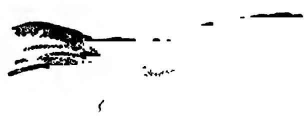
Taking a fish of the ordinary shape, such as a perch,

carp, or cod as a type, the general structure may be briefly indicated. The body may be divided into three portions, *head*, *trunk*, and *tail*, the head extending to the gill-opening and the trunk to the vent. The thoracic part of the body is thrown forward towards the head, so that fishes may be said to have no neck. In the head are situated the heart and the organs of respiration as well as the brain.

The locomotion is effected by means of *fins*, which are of two kinds—vertical or unpaired, and horizontal or paired. The vertical fins are developed in the median plane of the fish. In the embryonic condition they appear merely as a fold of skin edging the whole upper portion of the body, and extending round the tail to the vent. This fold of skin is usually supported by rays which may be solid and pungent, when they are named spines, or flexible and jointed, either simple or branching, when they are called soft rays. These fin-rays are continuations of, or are articulated to, other rays supported by the vertebral column. The continuity of the vertical fin is usually interrupted, parts being arrested in their growth and disappearing while other parts continue to increase. In this way several fins may be distinguished, the dorsal extending along the back, the anal placed on the ventral surface behind the vent, and the caudal forming at the extremity of the tail. The dorsal fin may be single or be broken up into two or three fins. In some fishes, as the salmon, some of the cat-fishes, &c., an additional dorsal fin, placed behind the others and without rays, is present: as fat is always deposited in the fold of skin composing this fin, it has received the name of fatty or adipose fin. The presence of spines or soft rays in the dorsal fin forms an important character in the classification of fishes. The anal fin may consist of one or more portions, or be entirely absent. The caudal fin is in the ordinary fishes externally symmetrical, being frequently crescent-shaped with two equal lobes. This form of caudal fin is called *homocercal* as opposed to *heterocercal*, the term applied to the caudals of sharks and sturgeons, in which the extremity of the vertebral column is prolonged through the upper lobe, which is longer and out of proportion to the lower lobe. In the homocercal tail, indeed, the symmetry is only on the surface, for the tip of the vertebral column is inclined upwards into the upper lobe of the fin. A truly symmetrical caudal fin (*diphycercal*) is found in a few fishes, such as some of the rays and the mud-fishes. The paired fins are the homologues of the limbs of quadrupeds. It is probable that like the vertical fins they are the remnants of a continuous lateral fin, specialized and highly developed. The first pair, the pectorals, are placed immediately behind the gill-opening. The second pair, the ventrals, are situated on the abdominal surface, but have a remarkable power of changing their position in relation to the pectorals, sometimes lying behind them, well back near the vent (abdominal), or further forward below the pectorals (thoracic), or even in front of the pectorals (jugular). The ventral fins may be entirely absent. Some fishes have no paired fins.



Homocercal Caudal Fin.



Heterocercal.

The caudal fin is the chief organ of locomotion, its action being similar to that of a screw. The pectoral fins serve principally to direct the fish's course, and, with the ventrals, to maintain its balance. When the fish dies and the fins cease their work, or if it be deprived of its fins, the proper balance is no longer maintained, and the fish floats with its belly uppermost. Retrograde motion can be effected imperfectly by forward strokes of the pectorals. In the flying fishes the pectorals act as a parachute; while in the gurnards, anglers, and some other fishes that live on sandbanks left dry at low tide, they are adapted for walking or hopping on land. Some fishes again, as blennies, walk on the sea-bottom by means of their ventral fins, while the gobies have these fins united into an adhesive disc, by means of which they can attach themselves firmly to rocks. Flat fishes and rays swim with an undulatory motion of their broad flattened body; eels, by alternate curvatures of the body.

The skin of fishes is generally covered with scales, which are horny products developed in pockets of the skin (cutis). Several kinds of scales are distinguished, namely—the CYCLOID, thin smooth scales; the CTENOID, thicker, rough, and toothed on the free margin; and the GANOID, angular bony scales covered with a layer of enamel. In some fishes, as sharks, file-fishes, rays, &c., true scales are absent, their place being taken by dermal spines or tubercles, or large osseous plates or scutes, all of which were formerly comprised under the common name PLACOID SCALES. Ganoid scales are most common in fossil fishes. The skin is often naked. Certain scales, forming a continuous series, in a slightly waved line from the head to the tail of the fish, are pierced in or near their centre, and furnished with a tube through which a slimy matter is poured, which serves to lubricate the body of the animal. This series of tubes forms a line visible on the sides of the body, which is termed the *lateral line*.

The bones of fishes are of a less dense and compact nature than in the higher orders of animals, and always remain in an isolated state, similar to that of the embryo of the Mammalia. Many fishes have a wholly cartilaginous skeleton. The skeleton may be divided into four chief parts—the vertebral column, the head, the respiratory apparatus, and the limbs. The vertebral column [see BACKBONE] in the ordinary bony fishes (see the skeleton of the perch, fig. 4, Plate III. BACKBONE) consists of vertebræ, which are concave at each end (*amphicœlous*). The space between each vertebra is filled with the gelatinous remains of the notochord. In this way a kind of ball-and-socket joint is formed, and the requisite degree of strength and mobility is gained. In one fish alone, the bony pike, the vertebræ are convex in front and concave behind (*opisthocœlous*). The vertebræ are divided into abdominal and caudal, the perch having twenty-one of each. The number of the vertebræ vary considerably, there being 270 in the tail of some sharks and only eight in the same region in the sun-fish. The transverse processes of the abdominal vertebræ support the ribs. The neural spines of the vertebræ support a series of flat spines (interneurals), to which the rays of the dorsal fins are articulated. In the same way the hæmal spines of the caudal vertebræ support a series of spines (interhæmals) to which the anal rays are articulated. The last caudal vertebra articulates with a a fan-shaped bone (hypural), which supports the caudal rays. In many fishes, as the mud-fishes, lampreys, sturgeons, &c., the notochord is persistent. In the lampreys and hags there is no trace of ribs or limbs. The ribs are rudimentary in the sharks and in some of the bony fishes, absent in the chimæras and some bony fishes.

The shoulder-girdle or pectoral arch in its simplest form, as in the sharks, is a cartilaginous arch placed just behind the branchial apparatus. This primary shoulder-girdle

undergoes degeneration and its place is usurped by the clavicle, a bone which reaches a considerable size in the bony fishes, and becomes the chief support of the pectoral fin. In the bony fishes the pectoral fin is suspended from the skull by the post-temporal bone. With this articulates the supraclavicle. The arch is completed below by the union of the large clavicle with that of the opposite side. The fore-arm consists of the coracoid and scapula, and the carpals, a variable number of small bones, followed by the rays of the fin. (The nomenclature of the bones of the pectoral arch varies exceedingly; the names employed here are those of Professor Parker.) The pelvic girdle is much reduced. The ventral fins are articulated to a pair of flat triangular bones, the pubic bones.

In the mud-fishes (Dipnoi) the pectoral fin differs in structure from that of ordinary fishes. It consists of a central axis made up of a number of cartilaginous pieces, which gradually become smaller and thinner towards the extremity. Each joint of the axis bears on each side a cartilaginous branch with one, two, or three joints. The diverging rays are sometimes suppressed. This type of limb is called crosso-pterygium, as opposed to ichthypterygium, the typical limb of fishes. The limb of higher vertebrates, which typically ends in a hand of five fingers, is called cheiro-pterygium.

The variations in the structure of the skull are very great in fishes. The skull of the perch may be taken as a type of the bony fishes, and the more important points in its structure touched on, as a complete treatment is impossible here. [See SKULL.] The skull is divided into the facial and cranial portions, the first of which is most developed. The brain is contained in the cranial cavity. The upper jaw consists of maxillary and intermaxillary bones. In the perch and the greater number of fishes the intermaxillary bones constitute the chief portion of the upper jaw, the maxillary bones being placed behind and parallel to them and articulated to the vomer. In the salmon tribe, and some other fishes, however, the intermaxillary bones are smaller in proportion, and form a continuous line with the fore part of the maxillary bones. In the sharks the maxillary and intermaxillary bones are reduced to mere rudiments, their upper jaw being the palatine. In the chimæras there is no separate upper jaw, it having fused with the cranium. The formidable weapon of the sword-fish is formed by the prolongation and coalescence of the maxillary and intermaxillary bones. The lower jaw or mandible consists of several distinct bones—the articulary, which articulates with the quadrate bone; the angular, a small distinct bone below the joint of the articulary; and a large bone, the dentary, which carries teeth.

Respiration is carried on by means of branchiæ or gills. The absorption of oxygen by fishes is small, and many of them can survive for several days out of their native element. A few breathe atmospheric air, having special contrivances for this purpose. The gills are very vascular tufts or plates developed upon the branchial arches, which are separated from each other by the gill-slits. On the interior edge of each arch there are two rows of knobs, cones, plates, or lancet-shaped processes beset with fine teeth; these are named gill-rakers, and act as sieves in straining the water and preventing gross substances from passing between the arches. Generally there are four gill-bearing arches, but sometimes the gills are fewer. In the embryo fish six arches may be perceived, and even seven are indicated, but the first is atrophied before the sixth is developed, and only five are matured. The fifth arch does not in general carry gills, but is beset with teeth, forming the lower pharyngeal bone.

Even in the more common fishes great modifications occur in the respiratory apparatus. The fourth gill is frequently entirely absent. In the bony fishes the tips of the gills are free, and there is only one external opening on each side, by which all the water, which, entering by the mouth, passes over the gills, flows out. This opening is regulated by a valve called the operculum or gill-cover, which consists of four pieces—viz. the pre-operculum, a chevron-shaped or crescentic bone bounding the cheek posteriorly; the operculum, often quadrangular, and filling the space between the pre-operculum and upper part of the gill-opening; the sub-operculum, lying, as its name denotes, under the operculum, and bordering the lower part of the gill-opening; and fourthly, the inter-operculum, which lies before the sub-operculum, and runs forward under the lower limb of the pre-operculum towards the mandible. Between the sub-operculum and inter-operculum of the one side and those of the other a membrane, named the branchiostegal, stretches across the throat, and fills the interval between the limbs of the mandible. It is distended on riblike bones, called branchiostegal rays, which are articulated to the segments of the hyoid arch. When the gill-opening is large, and runs forward to the root of the tongue, the branchiostegal membranes are narrow, and are completely separated from each other. The membranes are continued into one another when the gill-opening is small and high up. In sharks the gills are completely sunk in pouches, and there is no operculum.

The air-bladder is an organ peculiar to fishes. It has in many fishes a long duct communicating with the alimentary canal, of which it was originally an outgrowth. In other fishes it is entirely closed. In most fishes it is nothing but a hydrostatic apparatus for maintaining the necessary accordance between the specific gravity of the fish and that of the surrounding fluid. In a few fishes—the mud-fishes—it assumes the function of a lung. The air-bladder lies in the abdominal cavity. It may be divided into several intercommunicable compartments. In most fresh-water fishes the gas contained in the air-bladder consists of nitrogen, mixed with a very small quantity of oxygen; in marine fishes the latter gas predominates. The air-bladder is absent in hags, sharks, sturgeons, and allied fishes, and in some of the bony fishes which live on the sea-bottom. In some fishes, as cat-fishes and carps, the air-bladder is connected with the acoustic organs by chains of small bones.

The muscles of fishes are arranged on each side of the body in a series of successive flakes or segments (myotomes) which correspond in number to the vertebræ. The electric organs found in some fishes—the torpedo, electric eel, and electric cat-fish—have been developed out of muscular substance.

The nervous system of fishes is simple, but undergoes great modifications in the different divisions of the class. The brain is small, and does not entirely fill the brain-case. In its primitive condition the vertebrate brain is constricted into three vesicles—the fore-brain (prosencephalon), the mid-brain (mesencephalon), and the hind-brain (metencephalon), whose cavities at first freely communicate. These three primitive vesicles give rise to new segments, the twixt-brain (thalamencephalon) between the fore and mid brain, and the after-brain (myelencephalon) arising after the hind-brain, and directly continuous with the spinal cord (myelon), which is usually continued throughout the body. Some of the segments of the brain may be obscured externally by the overlapping of the anterior segments. In the common bony fishes the fore, mid, and hind brain, corresponding to the cerebrum, optic lobes, and cerebellum of higher vertebrates, are well developed. The fore-brain (cerebrum) consists of two rounded masses, in front of which are placed two olfactory lobes (rhinencephalon). The twixt-brain, which in sharks, &c., is distinct, is hidden by the approximation to the cerebrum of the mid-brain (optic lobes), which consists of two rounded masses generally larger than the cerebral hemispheres. The hind-brain (cerebellum) is usually small. The sharks

have a highly developed nervous system: the cerebral hemispheres and the optic lobes are more or less fused, each into one mass, and the olfactory lobes and cerebellum are greatly developed. The nerves are given off from the brain and from the spinal cord, from between the vertebræ.

As regards the senses, those of taste and touch appear to be but slightly developed in fishes. When we consider the quick manner in which the food is swallowed, without mastication, it would certainly appear that their sense of taste is very slight. The sense of touch is probably most developed in the barbels attached to the mouth of those fishes that have them. The long filaments with which the fins of some fishes are furnished also perhaps serve, through the sense of touch, to indicate the vicinity of weeds or other objects in the water.

The eyes are differently placed in the various species of fishes, in accordance with their habits; for the most part they are placed laterally, and in some (those that live at the bottom of the water) we find them directed upwards. In the flat-fishes they are on the same side of the body. In some species of sharks they are situated at the end of an elongated lateral process on each side of the head. The sight in fishes is acute; the range of vision, however, is somewhat limited. The eyes (which are furnished with a spherical lens) are generally large; but in some species they are very small, while others are destitute of them. In the stream which runs through the Mammoth Cave, Kentucky, more than one specimen of eyeless fish is found. In fishes inhabiting great depths the eyes are aborted, but down to a depth of 200 fathoms the eyes increase in size. Some fishes, as gobies, can elevate and depress their eyes at will. A lachrymal gland is absent. In the hags the eye is quite rudimentary, and is covered by the skin. Certain eyelike spots are found in some deep-sea fishes, some of which are blind, and others, as the species of the genus Scopelus, possess large eyes. These are small shining bodies embedded in the skin, either placed on the head or distributed along the side of the body, especially along the abdomen. Their function is still a mystery. By some they are regarded as accessory eyes. Probably they produce and emit phosphorescent light.

In fishes the organ of hearing is rather complicated; it is wholly within the head, and cannot be discovered except by dissection, the sharks alone having a fine tube leading to an external orifice from the interior labyrinth. The labyrinth has three semicircular canals communicating with a vestibule in which are contained two bony bodies, called otolites. In some fishes the labyrinth is connected with the air-bladder. The sense of smell in fishes is tolerably acute. The organ of smell has no connection with the mouth and the respiratory function. In the hag and lamprey the nasal sac is single, in other fishes it is double. In ordinary fishes the nasal cavities are placed at the sides or the top of the snout, in sharks on the under side.

The teeth of fishes present considerable variety in structure and numbers. They are found on almost every bone in the interior of the mouth—in the bones of the jaw, palatines, pterygoids, vomers, basi-sphenoid, glossohyal, as well as on the branchial arches and pharyngeal bones. Many fishes have long lancet-shaped teeth, capable of being bent inwards towards the mouth. In some the teeth are arranged in bands or patches. Some fishes are toothless. The teeth are always being shed and renewed. The mouth in sharks, sturgeons, and some bony fishes lies at the under surface of the snout. The hags and lampreys have a circular mouth without jaws. The tongue may be absent. There are no salivary glands. The alimentary canal is usually short and large, being as a rule shorter in carnivorous fishes than in those of herbivorous habits. The stomach in bony fishes is usually a large simple cavity, presenting the form either of a bent tube, as in the salmon, or of a pouch, as in the herring. The intestine in the bony fishes is simple, but in most other fishes it has a spiral valve. The liver is usually large, and generally forms a single undivided mass: in it a great quantity of the oil of the body accumulates. A gall-bladder and pancreas are usually present. Fishes are generally extremely voracious, and for the most part are carnivorous. Some devour even their own offspring. Some fishes feed on vegetable substances, others extract nutritive matter from mud. The food is generally swallowed whole; the stomach of some deep-sea fishes is so capacious and distensible that it can receive a fish of twice or thrice the bulk of the destroyer. Sharks tear their prey to pieces with their sharp teeth.

The circulation in fishes is of a simple type. The heart belongs to the branchial circulation alone, and not to the general circulation of the body, and so corresponds to the right half of the heart of mammals and birds. There is a single auricle (or *atrium*), which receives the venous blood from the body and forces it into the single ventricle. From the ventricle in the bony fishes arises the branchial artery, which is dilated at the base. The branchial artery divides and gives off a branch to each branchial arch. The aerated blood, which has passed through the gills, flows to the body, the main trunks uniting to form the aorta. In bony fishes and lampreys the dilatation above the ventricle is merely a swelling of the artery without contractility. This swelling is called the aortic bulb (*bulbus aortæ*). In all other fishes this swelling is formed by the drawing up of the muscular part of the ventricle from which it is not separated by valves; its interior is provided with a series of watchpocket-shaped valves. This is known as the ***conus arteriosus***. A portal circulation supplying the alimentary canal, and terminating at the liver by means of the ***vena portæ***, is found in fishes. [See CIRCULATION.] The heart is relatively small. The blood is red. The red blood corpuscles are elliptical, except in the lamprey, where they are almost circular. Among bony fishes they are largest in the salmon family. Those of sharks are larger, while one of the mud-fishes (Lepidosiren) has blood corpuscles nearly as large as those found in amphibians. The kidneys in the bony fishes are usually very long, lying along the abdomen close to the vertebral column. There are great variations as to their form among fishes. In the lampreys the kidneys are in an exceedingly primitive form, comparable to a series of the excretory organs (nephridia) of the Annelida, each opening into a common duct, instead of opening separately into the body cavity.

All fishes are of two sexes. The majority are oviparous. The eggs are usually small, and the number produced is enormous. Some fishes bring forth their young alive, and copulation takes place. Usually impregnation takes place after the roe or spawn is deposited. Many bony fishes take care of their progeny till the eggs are hatched. This especially maternal duty is usually performed by the males, the only two exceptions being in Aspredo, a genus of cat-fishes, and Solenostoma, allied to the pipe-fishes. Nests are not unfrequently constructed by the males, the best-known example being the sticklebacks. The eggs are carried about by other fishes in various places, in some cases in their mouth, in others in an abdominal pouch. Artificial impregnation of the eggs is now conducted with great success. The growth of fishes is very irregular, depending on the amount of food and favourable surroundings. The so-called Leptocephali, long band-shaped fishes with a skeleton almost entirely cartilaginous, which are found floating in the sea far from land, are regarded by Dr. Günther as the young of various kinds of fishes arrested in their development by being carried out of their normal surroundings. Many fish grow very rapidly. Instances of albinism are very rare among fishes. A kind of intermediate stage is not uncommon, in which the dark-coloured pigment cells become yellow. This is common among domesticated fishes, as the gold-fish and gold-tench. Hibernation, or

rather æstivation, is not unknown among fishes. In the tropics many fishes which live in ponds liable to dry up, bury themselves in the mud, and pass through the dry season in a state of torpidity.

Poisonous properties are found among fishes. The flesh of some is poisonous when eaten. These include tropical species of herrings, globe-fishes, file-fishes, tunnies, &c. Their deleterious properties are in nearly all instances due to their food, which consists of corals, poisonous Medusæ, or decomposing substances. Some common fishes cause illness if eaten during the spawning season. Poison organs are sometimes, though rarely, developed among fishes. In a fish found in South America (genus Thalassophryne, family Batrachidæ) the operculum is armed with a spine closely resembling the venom-fang of a serpent. The spine is hollow, and communicates at its base with a poison-bag, the contents of which pass through the spine into the wound which it inflicts. The dorsal fin is armed with two similar spines. Two species of the genus Synanceia, common in the Indo-Pacific seas, have their dorsal spines provided with poison-bags. The spines found on the tail of the sting-rays, and on the dorsal fin and operculum of the weavers and some species of the family Scorpænidæ, cause such severe wounds that it is thought the mucus secreted from the fish's body must possess poisonous properties.

The usefulness of fishes to man consists chiefly in their supplying him with food. The skin of sharks and rays yields shagreen, and the air-bladder of sturgeons and some others isinglass. Artificial pearls are made from the scales of the bleak and other fishes. The liver of many fishes yields oil for medicinal and other purposes.

With reference to the general intelligence of fishes Mr. Romanes ("Animal Intelligence") says:—"Fish display emotions of fear, pugnacity; social, sexual, and parental feelings; anger, jealousy, play, and curiosity." Parasitism is rare among fishes. The hag is a true parasite, penetrating into the abdominal cavity of fishes, such as the cod, and devouring its host. Several instances of *commensalism* occur, the parasites living either inside or attached to the outside of their host without doing it any injury. The sucking-fishes make up for their feeble powers of locomotion by attaching themselves to whales, sharks, or even ships. A cat-fish lives in the mouth cavity of another fish of the same family. Species of star-fishes, sea-cucumbers, and sea-anemones give shelter to certain little fishes of the genus Fierasfer and some others, which live inside their hosts in the capacity of "messmates" rather than of parasites.

Classification.—The classification of fishes is one of the points upon which zoologists at present agree to differ. The Lancelet (Amphioxus) is considered by many to be a fish. This creature, two species of which are now known, has no skull, brain, limbs, nor heart. The notochord is presistent, and the skeleton membrano-cartilaginous. It seems an abuse of language to call such an animal a fish, separated as it is from fishes by a gulf as wide as that which separates them from mammals. Amphioxus logically forms a primary division of the subkingdom Vertebrata. Such a position has been found for it in the classification of modern writers under the names Leptocardia, Acrania, or Cephalochorda [see LANCELET], as opposed to Craniata, which includes all other vertebrates. MONORHINA (or Cyclostoma), comprising the hags and lampreys, again is separated from the class fishes by some zoologists, looking to the striking differences between these animals and other fishes. If Monorhina is excluded the class Pisces may be divided into four subclasses, CHONDROPTERYGII, HOLOCEPHALI, GANOIDEI, and TELEOSTEI. The Teleostei are the common bony fishes. Though far outnumbering the other subclasses, and though they are commonly regarded as the typical fishes, the Teleostei are a special line of development out of the direct line leading to the Amphibia. The other subclasses are more ancient and approach the amphibians more nearly; indeed, the distinction between the mud-fishes and some of the latter class is very slight. These three subclasses Dr. Günther unites into one, which he calls Palæichthyes, or ancient fishes. The Ganoidei includes the sturgeons, the bony pike, and a few other living forms, together with an immense number of fossil forms. With them Günther includes the mud-fishes, which for others form a separate class (DIPNOI). The Ganoidei are in many respects intermediate between the Teleostei and the Chondropterygii (sharks and rays). The Holocephali contains only two living genera, Chimæra and Callorhyncus.

In the Plate are figured the skeletons of a few typical fishes for comparison. Fig. 1 represents the common skate, one of the rays. The pectoral fins (of which the right alone is figured) are greatly expanded, and form the sole organs of locomotion, the caudal fin being suppressed. It is interesting to compare with the rays the flat-fishes (fig. 4), which are also adapted for a life on the sea-bottom, and like them have a flattened disc-like body, by undulation of which they move. The peculiar shape of the skate is due to *vertical depression*, that of the flounder to *lateral compression*, so that the dorsal and anal fins of the latter correspond in function to the pectorals of the former. Fig. 2 is the skeleton of the sterlet, one of the sturgeons, showing the eminently heterocercal tail. The skeleton is cartilaginous, and the notochord persistent. Figs. 3 and 5 are skeletons of nearly allied fishes. The eel (fig. 5) has an extremely elongated body; its vertical fin extends along the back round the tail to the vent, and is not split up into dorsal, caudal, and anal fins, as in the carp. The carp (fig. 3) has well-developed ventral fins; the eel has none.

Fossil Fishes.—From the cartilaginous nature of the skeleton of many fishes the study of the fossil forms of this group is attended with peculiar difficulties—scales, spines, or teeth being frequently the only things which survive to tell us of the nature of the animals of which they once formed part. Certain minute pointed horny bodies, known as conodonts, have been obtained from deposits belonging to the Lower Silurian measures. These are considered by some to be the teeth of fishes, but should most probably be referred to the Mollusca and the Annelida. The first evidence of the appearance of the Vertebrata on the earth is afforded by the occurrence in the Ludlow rocks of the Upper Silurian age of spines and shagreen-scales of a fish, probably one of the sharks, coupled with what is believed to be the jaw of a fish belonging to the Placodermi, a division of Ganoidei. The remains of fishes in the Devonian or Old Red Sandstone epoch are very abundant. Besides spines of sharks remains of Ganoid fishes abound, especially of those with great cephalic bucklers, as Cephalaspis and other genera, forming a special division, PLACODERMI. Throughout the Carboniferous and Permian ages Ganoids and Chondropterygians abound. At the commencement of the Secondary epoch the Ganoids begin to decline. In the Cretaceous period the Teleosteans make their appearance, and soon become predominant.

("An Introduction to the Study of Fishes," by Albert C. L. G. Günther, Edinburgh, 1880; R. Owen, "Lectures on the Comparative Anatomy and Physiology of the Vertebrate Animals: Part I., Fishes," London, 1846; T. Huxley, "A Manual of the Anatomy of Vertebrated Animals," London, 1871; C. Gegenbaur, "Elements of Comparative Anatomy," translation, edited by Professor Ray Lankester, London, 1871; "Catalogue of Fishes," published by the Trustees of the British Museum, London, 1859–70; "Voyage of H.M.S. *Challenger*: Fishes," by A. Günther.)

FISHING-FROG. See ANGLER.

FISHING TACKLE is the subject of varied branches of industry, principally nets, hooks, flies, baits, rods, &c. The knitting of fishing-nets has been carried on from time

immemorial in and near seaside towns, by the wives and families of fishermen. Machine-made nets, however, are now rapidly superseding hand-made, and cotton is superseding hemp, the former being nearly twice as durable, especially when "tanned." A very fine collection of netting line was exhibited in the London Fisheries Exhibition, 1883.

Limerick fish-hooks had at one time a great reputation, but the manufacture is now chiefly carried on at Redditch, Worcestershire, where about 4,000,000 fish-hooks are made weekly. The process of manufacture is nearly as follows:—Wire of the proper thickness is unwound from a reel, cut into pieces of a proper length, bearded or notched, filed, sharpened to a point, and bent to the proper shape; the hooks are then hardened, the stiffness and elasticity of steel being imparted to the iron by sudden immersion into heated charcoal, or other processes. After undergoing annealing they are then shaken in bags of oil and emery, scoured in acid liquor, washed in soap-suds, dried in sawdust, blued in a kiln, washed and dried again, then papered and packed. Most of the processes are automatically performed, one man with one machine being able to make 6000 hooks per hour. There are more than fifty different sorts of fish-hooks, each having from twenty to thirty sizes.

The flies are made by women and girls, the feathers of the jay, starling, woodcock, golden pheasant, and other birds being used. Brilliant baits are sometimes made of electro-plated metal. The floats are made of wood, cork, wire, silk, quill, and putty, finished off with paint and varnish. The rods are of bamboo, hickory, cane, ash, lancewood, or hazel; the wood is sawn, turned, bored, planed, stained, fitted, and varnished. Eel spears, harpoons for fresh and salt water fish, reels, swivels, leads, small shot, gut lines, hair lines, are among the other articles in fishing tackle. One large establishment at Redditch combines the making of most kinds of fishing tackle with that of hooks, but more frequently the tackle-makers purchase hooks ready made. See ANGLING.

FISH-LOUSE is the common name applied to certain degraded crustaceans parasitic on fish. In some of the fish-lice the degradation is very complete, the organs of locomotion being lost and the whole body being so modified as to present a very grotesque and bizarre appearance. The fish-lice find their nearest relation in the beautiful little Cyclops and other Copepods, which when young they closely resemble. They are often treated as a separate subclass of the Crustacea under the name Epizoa. See EPIZOA.

FISH-OWL is the name given to some species of OWLS, distinguished by having the tarsus and toes bare of feathers and covered with a granular or irregular scaly skin. The soles of the feet are covered with small spicules. The fish-owls, as their name denotes, prey upon fish. They inhabit India and the Malay Archipelago. Three species have been described, referred to the genus Ketupa. The Ceylon fish-owl (*Ketupa ceylonensis*) is found not only in Ceylon, but in most parts of India. It is a large and powerful bird, haunting the banks of rivers, tanks, &c. Its principal activity is in the twilight. The food consists of fish principally, but also of small mammals, reptiles, and insects. Another species (*Ketupa flavipes*) is found commonly in India, especially towards the north, and also abounds in the Indian islands and in Siam. It is a large, heavy, clumsy, but powerful bird, which flies well by day, and is usually found in the vicinity of rivers, where it preys upon fishes and crabs. Among the Siamese, according to Mr. Finlayson, "the skull of this bird is held in considerable estimation as a medicine in small-pox, and chiefly to check and alleviate the itching sensation which takes place in the curative stage. For this purpose the head is rubbed upon a stone with water, which thus impregnated is received into a vessel, from which an attendant spurts a quantity of it on the body from time to time." The third species (*Ketupa javanensis*) is peculiar to Java.

FISH-SKIN, the covering of the flesh of marine animals, is used in the arts for a variety of purposes. Thus the rough skin of the shark, or dog-fish, is used by whitesmiths, cabinetmakers, type-founders, and others, as an abrasive material for smoothing metals and woodwork. The skins of the seal, porpoise, beluga, &c., are brought into use by tanning, and a sort of shagreen is made of fish-skin. Sole-skins are used for clarifying coffee and liquors; and eel-skins are converted into strong ropes for connecting the swiple and handstaff of a thrashing-flail, and for many other similar purposes.

FISSIROS'TRES. See VOLITORES.

FIS'SURE is a general term applied to a rent or break in a rock, but where displacement or shifting has accompanied fracture the case is spoken of as a FAULT. Fissures vary in size, from thin cracks into which a knife could scarcely be thrust, to wide and deep chasms. Frequently they are filled by infiltration with minerals of a different nature to that constituting the mass of the rock. Mineral lodes are cases of this nature, so are the thin seams of quartz and calcite frequently found in much disturbed rocks. Fissures often result from the widening of pre-existing cracks caused by jointing.

FISSUREL'LA. See KEY-HOLE LIMPET.

FIS'TULA, an ulcer in the form of a narrow canal, more or less deep and sinuous, lined by a pale false mucous membrane, indolent and indisposed to heal, kept up by some local pathological condition of the soft parts or bones, or by the presence of some irritating foreign body, and leading or not to a suppurating cavity. There may be a single external or internal opening, or there may be a communication between the skin and the mucous, serous, or synovial cavity. Fistulæ arise when abscesses are not thoroughly healed from the bottom, when any irritating substance (as a ligature or piece of dead bone) remains in the tissues, or after wounds of excretory ducts. The principles of treatment are, to remove the cause; to prevent the accumulation of matter, by counter openings if necessary, and by properly directed compression; to excite adhesive inflammation by pressure, stimulating injections, and applications; and, as a last resort, incision of the fistula, that the soft parts may have an opportunity of healing from the very bottom of the wound. The constitution should also be nourished by strengthening diet and tonic medicines. The most common varieties are the anal, lachrymal, salivary, and urinary fistulæ.

FISTULA'RIA. See FLUTE-MOUTH.

FITS, a popular term applied to any sudden and unusual manifestation of a disturbance of the animal system, especially if accompanied by insensibility or convulsive muscular action. The term is not used in scientific medicine, any sudden development of disorder in the system being called a seizure. See APOPLEXY and EPILEPSY.

FITZ is the old Norman form of the French word *fils*, meaning son. It is prefixed to proper names, in the same manner as the Scotch *Mac*, the Irish *O'*, and the Hebrew *Ben*, and indicates descent from the ancestral name following it. It has been applied to denote the natural sons of royalty, as in Fitzroy, Fitzjames, and Fitzclarence.

FITZJAMES. See BERWICK, DUKE OF.

FITZROY, VICE-ADMIRAL ROBERT, chief of the meteorological division of the Board of Trade, and in his day famed for his meteorological knowledge and for his system of forewarning stormy weather, was the youngest son of General Lord Charles Fitzroy. He was born in 1805, entered the royal navy in October, 1819, and became a lieutenant in 1824. He was commander of the *Beagle* from 1828 to 1836, in important hydrographical operations in South America and elsewhere, carrying on surveys and constructing a chain of meridional distances round

the globe. This was the expedition in which Darwin took part, and of which part he wrote a delightful narrative ("Researches," &c., London, 1839). Fitzroy was M.P. for Durham from 1841 till 1843. In 1843 he was made governor of New Zealand, which appointment he held until 1846. He obtained the rank of rear-admiral in 1857, and that of vice-admiral in 1863. He died on the 30th April, 1865, from an act of suicide committed while in a state of mental derangement. Admiral Fitzroy's method of storm warnings undoubtedly contained the foundation of a system which further experience and observation has rendered very valuable in saving life. The system of combined meteorological observations is now carried to a pitch not dreamed of when Fitzroy began the work. See METEOROLOGY.

FIU'ME, a seaport town of Hungary, in the province of Croatia-Slavonia, beautifully situated on the shore of the Adriatic, at the mouth of the Fiumara. It is distant 40 miles S.E. of Trieste, and has 18,000 inhabitants. It consists of an old town standing on a hill, and a new town which is well built, with wide handsome streets running along the shore. Fiume is a free port, and the only port of Hungary. It is connected by railway with Trieste and Vienna on the one hand, and with Pesth on the other. It is the residence of a military governor, and has a gymnasium, several fine churches, one of which is dedicated to St. Veit, whence the town has its German name. It communicates with the interior of the empire eastward by a magnificent road called the Louisenstrasse (in honour of Maria Louisa), completed in 1803, crossing the Julian Alps at an elevation of 3000 feet, and conducting to Carlovaczes, where the Save and Kulpa become navigable for small steamers. The harbour has been so much improved that it is now one of the best in the Mediterranean, and the trade is very flourishing, the chief exports being flour, wine, and staves, the latter being obtained from the lowlands between the Drave and the Save, which contain a marvellous growth of oak trees, the wood of which splits almost as thin as a slate, and is a material unique of its kind for barrels. The principal manufactures of Fiume are cloth, linen, wax, hats, tobacco, earthenware, sugar, and leather. Shipbuilding is actively carried on, and there are tanneries, rope manufactories, and other industrial establishments, including Whitehead's torpedo factory, and Messrs. Smith and Maynie's paper-mills.

FIVE THOUSAND, THE, the imaginary aggregate of specially chosen citizens of Athens, brought into being by the *coup d'état* of Peisander and Antiphon to cloak the real tyranny of the FOUR HUNDRED which they inaugurated. The revolt of Samos, and finally of Athens, converted the hitherto non-existent five thousand into a reality; the four hundred oligarchs were deposed and brought to trial, and though nominally the roll of empowered citizens stood by law at five thousand, every citizen who could show a proper war-panoply was admitted without further question. Thus in 411 B.C., after only a few months of oligarchy, Athens for a time regained her ancient democratical constitution. She was soon, however, to fall (in 404 B.C.) before the despotism of the THIRTY TYRANTS.

FIVE-MILE ACT. This was part of the legislation of Charles II. against the Puritans, which ended in the production of the strong Nonconformist religious element (or, as they were formerly generally called, the Dissenters), so peculiar to our country.

The Act of Uniformity came into operation, and a fifth of the English clergy were driven from their parsonages, on St. Bartholomew's Day, 1662. Next year Catholic priests were banished. In 1664 the Conventicle Act fined, imprisoned, or transported all meetings of more than five persons for any religious worship but that of the Common Prayer. The Five-mile Act in the following year completed the code of persecution. By this infamous statute every nonconforming clergyman was compelled not only to swear that he held it unlawful to take arms against the king, but also to swear that he would never seek for any alteration in either church or state. If he refused he was banished to the country, and dare not, under pain of imprisonment, approach a town within five miles. As the main body of the Nonconformists belonged to the trading classes this Act robbed them of any religious teaching at all, except from ministers who would be base enough to forswear their consciences. It is almost needless to add that it is difficult to find a single instance of such a one.

The Church of England had freed itself from the Roman Catholics, but by casting out Puritanism or Lutheranism under Charles II., it condemned itself to stand aside from the great march of religious progress. It is one of the signs of the times that the good fellowship so long denied once more exists freely among us, though up till now the church still feels unable to include the whole national religious life within her capacious bosom.

FIVES, an ancient and popular game deriving its name either from the circumstance that all scoring in it is reckoned by multiples of five, or because the ball is struck with the five fingers of the hand. The game consists in the opposing players alternately striking with the hand a small ball, about two inches in diameter, against a wall above a certain line; on the rebound of the ball the player whose place it is to return it must do so not later than the first bound from the ground. The game is said to correspond to a certain extent with the Greek *aporrhazis* and the *jeu de paume* or palm play of France and England in the fifteenth century.

FIXED STARS. See STARS.

FIXTURES. It is necessary, in order to constitute a fixture, that the article should be let into or united with the land, or to other substances previously connected therewith. Goods, and even buildings of the most ponderous description, do not fall under the description of fixtures, if they are merely laid and rest upon the earth without being let into it. Something more than mere juxtaposition is required, as, for instance, that the soil shall have been displaced for the purpose of receiving the article, or that the thing shall have been connected or otherwise fastened to some fabric previously attached to the ground.

Questions as to fixtures arise principally between three classes of persons: (1) between landlord and tenant; (2) between the executors of a tenant for life or in tail and the remainder-man or reversioner; and (3) between the heir and the executor of the party who attached the article to the premises.

Everything permanently affixed to the soil is in law a fixture. However, between landlord and tenant it has a more restricted meaning, and may be divided into "tenant's fixtures" and "landlord's fixtures." Tenant's fixtures are personal chattels annexed to the freehold by the tenant during the term, either for the purposes of trade, or for mere ornament and convenience, and which he has a right to remove while he is in possession, but not after he has removed. Landlord's fixtures are those he himself has put up. All trade fixtures may be removed by the tenant which were of a perfect chattel nature before they were put up, or have in substance that character independently of the soil, and may be removed without material injury to the freehold. Removable fixtures for ornament and convenience are pier-glasses, cornices, chimney-pieces, slabs, window blinds, grates, coppers, pumps, iron ovens, and the like.

FLAC'CUS, CAIUS VALE'RIUS, was born at Padua according to some, or at Setia in Latium according to others. Flaccus lived under Vespasian, and was a contemporary of Martial, who addressed to him one of his epigrams. He seems to have died young at Padua. He

wrote his "Argonautica" in imitation of Apollonius Rhodius. The poem is full of digressions and episodes, amidst which the main action languishes. Some of the descriptions, however, are good. His style is at times obscure, and he is fond of displaying his erudition. There are only eight books of his "Argonautica," the last of which is incomplete.

FLACOUR'TIA is a genus of plants, natives of the hottest parts of Asia and Africa. Flacourtia was named in honour of Etienne de Flacourt, a director of the French East India Company, and the commander of an expedition to Madagascar in 1648. The species are thorny shrubs, with whitish sepals and yellow stamens. *Flacourtia Ramontchi* has a fruit which is edible, about the size of a small plum; it is red when ripe, but at length becomes violet coloured, and has a sweet and acid taste. It is a native of India, tropical Africa, and Madagascar. *Flacourtia sapida* is a native of the mountainous districts of India, and the fruit is about the size of a common currant, of a red colour, and is eaten by the natives. It is considered to be a variety of the former species by Hooker in his "Flora of British India." *Flacourtia inermis* has reddish-purple berries of a pleasant acid taste. It is a native of the Moluccas, where it is also extensively cultivated for the sake of its fruit.

This genus belongs to the order Bixineæ. The flowers are either male or female, growing on separate plants. There are four or five scale-like sepals, no petals, several stamens with short anthers. The ovary, with two to eight cells and two to eight styles, ripens into a succulent fruit.

FLAG (from the Anglo-Saxon *fleogon*, to fly or float in the wind), the ensign or colours of a ship. Flags borne on the masts of vessels designate the country to which they respectively belong, and they are likewise made to denote the rank of the officer by whom the ship is commanded.

The supreme flag of Great Britain is the royal standard, which is only to be hoisted when the queen or one of the royal family is on board the vessel; the second is that of the anchor on a red field, which characterizes the lord high admiral, or lords commissioners of the admiralty; and the third is the union flag, in which the crosses of St. George, St. Andrew, and St. Patrick are blended. This flag is appropriated to the admiral of the fleet.

In the British navy the centre division of a fleet used to be distinguished by red colours, the van by white, and the rear by blue; these divisions being respectively commanded by an admiral, a vice-admiral, and a rear-admiral. But by admiralty circular of 5th August, 1864, these distinguishing colours of red, white, and blue were abolished in the royal navy, and the white alone retained—all her Majesty's ships of war in commission being required to bear a white ensign, with a red St. George's cross, and the union jack in the upper canton. The blue ensign and union jack is now appropriated to vessels employed in the service of a public office, or those commanded by officers of the Royal Naval Reserve, and the red ensign and union jack is borne by all other British ships, as the national colours, except such as may be allowed specially to bear any other distinguishing flag. Now the admiral, vice-admiral, and rear-admiral—who are termed flag-officers—are distinguished by carrying their flags at the main-top-gallant-mast head, fore-top-gallant, and mizen-top-gallant respectively.

The Plate prefixed to this volume shows the royal standards of the three kingdoms, the flags above mentioned, and also the standards and naval and mercantile marine flags of the chief nations of the world.

Several methods of signalling by means of flags both on land and sea have been invented; and at sea flags are also used for other purposes—*e.g.* a flag reversed signifies distress, the striking of the flag surrender, and the placing of the flag of one country above another denotes the capture of the vessel by the former. A white flag is the universally accepted signal for a truce, and a yellow flag of quarantine. A black flag at sea denoted in former times a pirate; when shown in war it signified no quarter asked or given.

FLA'GELLANTS, FLAGELLA'TION. The idea of propitiating the Deity by self-torment dates from a remote antiquity. Herodotus relates (ii. 42) that the Egyptians flogged themselves at one of their annual celebrations. Flagellation was administered as a trial of fortitude to the young Lacedæmonians, who it seems, in accordance with the peculiar institutions of Lycurgus, did not attach to this castigation the idea of degradation which modern Europeans do. In Rome, however, the punishment of flagellation was only applied to slaves, and it seems to have been pretty common, as different classes of slaves derived their names from the kind of whips with which they were lashed. Some were called *Hestiones*, because they were lashed only with cords; others *Bucedæ*, from being flogged with thongs of ox-leather. The Jews employed flagellation as a punishment, but never as a voluntary act of devotional exercise. This practice was unknown to the primitive Christians. The first known instances of this kind of self-mortification occur about 400, and from that time they became continually more frequent till the year 1056, when Cardinal Peter Damian de Honestis promoted by all his influence the practice of self-flagellation, which the learned author of the "Ecclesiastical Annals," Cardinal Baronius, calls "a laudable usage of the faithful." About the year 1260 the intoxication was complete. People began to perform their flagellations in public, on pretence of greater humiliation. Regular associations and fraternities were formed for that purpose, and the extravagances were so great that contemporary writers seem to have been struck with astonishment. The Flagellants were soon accused of many crimes. The celebrated Gerson attacked them in his writings, and Pope Clement VII. declared them heretics, and as heretics many of them were burnt. It was, however, with great difficulty that this sect was completely extirpated.

FLAGELLA'RIEÆ is an order of plants belonging to the Monocotyledons, series Calycinæ. Placed by Endlicher as a genus of the order Junceæ, it is admitted of ordinal rank by Bentham and Hooker. There are six species in three genera, natives of the warmer regions of the Old World. The leaves are lance-shaped, sheathing the stem at the base, and ending in a spiral tendril. The flowers are regular, arranged in a panicle. The perianth consists of six coloured segments, the three inner being the largest. There are six stamens. The ovary is superior, three-celled, the ovules solitary in the cells, anatropous. The fruit is about the size of a pea, succulent or drupaceous, containing a single seed.

FLA'GEOLET, a small musical instrument on the principle of a whistle, played on by means of a mouth-piece. Its compass is two octaves, from f', the first space in the treble stave, to f''' in altissimo. The scale of the quadrille flageolet is rather more limited. The flageolet is really the old *flûte à bec*, or flute blown lengthwise instead of from the side. This is the old English flute, remarkable for sweetness, but of little power. The *flauto traverso*, now quite in possession of the term flute, bore its Italian name just given, or was called the German flute, when first introduced. The *flûte à bec* was also called in Rousseau's time (he notes the fact) the *flûte d'Angleterre*. The tone of these old English flutes is produced on exactly the same principle as that of the flutes blown transversely; it is the breath vibrating against a sharp cutting edge that gives the tone of origin, and the vibrations of this tone of a definite musical pitch are then selected and reinforced by the resonance of the pipe. The whistle, old English flute, and

flageolet alike direct the wind through a narrow channel against the "fipple," the old term for the sharp edge; the transverse flute (the flute of modern days), being played by the lip, has to do with a source of vibration that can itself be controlled. In this way none of the vibrations are lost, for the lip itself quickly picks up the period of vibration of the tube, and the tone becomes full and sonorous. Organ pipes (the "flue work or diapasons," not the "reeds") are constructed on exactly the same principle. Take off the hollow head of the flageolet serving as a wind-chamber, and the narrow slit directing the wind towards the sharp edge of the hole in the side of the tube beneath can be readily seen. The flageolet can be played thus bare, but the head and the little ivory mouth-piece are found to assist the player. This form of instrument is very ancient; Egyptian paintings of the time of Moses show performers upon it. The RECORDER (made immortal by its introduction in "Hamlet") was one of the predecessors of the flageolet.

The *double flageolet* was invented by Bainbridge in 1800, producing two sounds, one from each pipe, usually in thirds—a method also found in all the nations of antiquity, including the Egyptians, as shown in the ancient pictures before mentioned. The limited capability of the instrument for duet playing, beyond simple passages in thirds, &c., soon caused it to fall into disrepute. It is now hardly to be met with, even as a curiosity.

FLAGEOLET TONES, a name sometimes given to the harmonics of stringed instruments.

FLAM'BOROUGH HEAD is the most projecting point of the chalk cliffs that run in an unbroken line from Bridlington quay, rising in many places from 300 to over 400 feet. The head itself is not the highest point, which is about a mile beyond the northern end of the dyke, and here the cliffs are 436 feet in height. From the action of the sea the chalk has been worn into many caves, while in other places it has formed spires and needles, which are the most picturesque where the resistance has been greatest. On the Head, 250 feet above the sea, is the lighthouse, 80 feet high, showing a revolving light, visible 30 miles. The view from the summit is a very grand one. Flamborough Head was the old *Ocellum Promontorium* of Ptolemy, and in more modern times is noted for the capture of James I. of Scotland (when Earl of Carrick) when on his way to France; and subsequently for an action, 1779, between two English ships and Paul Jones, the pirate, with a fleet of four vessels.

FLAMBOY'ANT, a style of Gothic architecture prevalent in France during the fifteenth and sixteenth centuries, so called from the frequent occurrence of flame-like forms in the tracery.

FLAME is the combustion of gaseous or volatilized matter. It is attended with great heat, and sometimes with the evolution of much light; but the temperature may be intense when the light is feeble; this is the case with the flame of burning hydrogen gas, it being scarcely visible by daylight, though its heat is intense.

In the burning of a candle the wax or tallow, being first rendered fluid by heat, rises in the wick, and although the wick supplies some hydrogen and carbon, by far the greater portion of these is yielded by the wax or tallow, which burn by the assistance of the oxygen of the air. The supply of hot vapour diminishes as it ascends, and eventually fails, and hence the flame of a candle gradually tapers to a point and then ceases.

A simple flame, such as that of a lamp or candle, consists of three portions. The dark central part, easily rendered evident by depressing upon the flame a piece of fine wire-gauze, consists of combustible matter drawn up by the capillarity of the wire and volatilized by the heat. This is surrounded by a highly luminous cone or envelope, which, in contact with a cold body, deposits soot. On the outside a second cone is to be traced, feeble in its light-giving power, but having an exceedingly high temperature. The explanation of these appearances is easy. Carbon and hydrogen are very unequal in their attraction for oxygen, the latter greatly exceeding the former in this respect; consequently when both are present, and the supply of oxygen limited, the hydrogen takes all, to the exclusion of a great part of the carbon. This happens in the luminous portion of the flame, the particles of charcoal becoming intensely ignited by the burning hydrogen. In the exterior cone, which is but faintly visible, these particles of carbon meet with new oxygen and undergo combustion.

Bright luminous flames are generally caused by the presence of incandescent solid bodies; the flames of hydrogen, carbonic oxide, and alcohol all become luminous if powdered carbon, zinc, or lime be introduced. On the other hand, coal-gas gives a non-luminous flame when mixed with sufficient air to completely consume the carbon; as in the Bunsen burner, which gives a smokeless flame of intense heat; or as in the blowpipe flame, which gives a heat of greater intensity. Several bodies give to burning gases highly coloured flames, as sodium, yellow; copper, green; strontium, red. [See SPECTRUM ANALYSIS.] Flames are unable generally to pass through wire gauze. [See SAFETY-LAMP.] They are usually extinguished by stopping the supply of air, in ordinary domestic cases by throwing a rug or blanket over the fire. In large fires, in some cases sand or ashes are used to cover them in; but the only method usually employed in large towns is that of using large quantities of water, which acts by cooling the materials. It often does much damage, and is not always advantageous; indeed, in some intense fires it may become a supporter of combustion and add fuel to the flames. Several fire-annihilators are employed; the principle is generally the instant development of carbonic acid, which is pumped out to the flames, and acts as a non-supporter of combustion. Fabrics may be made uninflammable by dipping them in solution of tungstate of soda. For various illustrations of flame see BUDE LIGHT, ELECTRIC LIGHT.

FLAME-BEARER (Selasphorus) is a genus of HUMMING-BIRDS (Trochilidæ). The Red Flame-bearer (*Selasphorus rufus*) may be taken as an example of this genus. This species is peculiar, as indeed are all humming-birds, to America. It passes the winter in Mexico, and advances during the summer as far north as Nootka Sound, where it was observed in abundance by Captain Cook. In all its migrations it keeps strictly to the western side of the Rocky Mountains, and thus represents on the west coast of North America the ruby-throat of the eastern or Atlantic districts. The male of this charming little species, which measures about 3½ inches in length, has the upper surface cinnamon-brown, including the tail-feathers, which are of a lanceolate form, and tipped with dark brown; the wings are purplish-brown, with their coverts bronzed; the throat is adorned with a large triangular gorget of a most brilliant golden orange-red; the breast is white, and the rest of the lower surface cinnamon-brown. In some males the back is of a green colour; and this is also the case in the females, which have the tail-feathers black tipped with white, and in place of the brilliant gorget of the males, a fiery red spot on the tips of most of the feathers of the throat. The males are excessively quarrelsome during the breeding season, when their burnished gorgets look like a brilliant live coal; and they emit a sort of bleating note which scarcely sounds like the cry of a bird. They often rise to a great height in the air, and then descend instantaneously almost to the surface of the ground; and during this descent, according to Dr. Townsend, they emit "a strange and astonishingly loud note, which can be compared to nothing but the rubbing together of the limbs of trees during a high wind." The

nest measures 2¼ inches in height, and three quarters of an inch in breadth at the top; it is composed of mosses, lichens, and feathers, with a few slender root-fibres, and is lined with the fine down of seeds. There are several other species of this genus, all exhibiting the same metallic brilliancy in their gorgets.

FLA'MENS, one of the orders of priesthood in ancient Rome, like the Salii, the Feciales, and others, instituted, according to tradition, by Numa Pompilius. The several flamens (*flamines*) were destined to the service of some particular deity. There was the Flamen Dialis, who was consecrated to the worship of Jupiter, and was the first in rank; the Flamen Martialis, who attended to the worship of Mars; the Flamen Quirinalis, attached to the god Quirinus. These three, the "greater flamens," were patricians, and there were twelve other or "lesser flamens," who were plebeians. The Flamen Dialis was a senator by virtue of his office, and held many very high privileges. All flamens were elected by the people.

FLAMIN'GO (Phœnicopterus), a genus of birds whose natural position seems to be between the wading birds, as storks and herons, and the ducks (Anatidæ). Accordingly these birds are variously assigned to the orders GRALLÆ and ANSERES. Professor Huxley keeps them distinct from both, making them the type of a distinct group, to which he gives the name Amphimorphæ. The close correspondence of many parts of the organization of the bird with the same parts in the Anatidæ is certainly very palpable; accordingly most authorities are disposed to place the genus under the order Anseres, making it the type of a family Phœnicopteridæ.

The legs of the flamingo are very long, and naked far above the articulation of the tarsus, as in the Grallæ. The

Head of Flamingo.

feet are webbed like those of a duck. The neck is very long. The wings are moderate. The bill presents great peculiarities. It is laminated, strong, higher than it is broad, conical towards the point, and naked at the base; the upper mandible is suddenly bent, curved at its point on the lower mandible, which is larger than the upper. The tongue of the flamingo is remarkable for its texture, magnitude, and peculiar armature. It is almost cylindrical, but slightly flattened above, and obliquely truncate anteriorly, so as to correspond with the form of the inferior mandible. The lower part of the truncated surface is produced in a pointed form, and is supported beneath by a small horny plate. The whole length of the tongue is 3 inches; its circumference. 2½ inches. Along the middle of the flattened superior surface there is a moderately deep and wide longitudinal furrow, on either side of which there are from twenty to twenty-five recurved spines, but of a soft and yielding horny texture, measuring from one to three lines in length. These spines are arranged in an irregular alternate series, the outer ones being the smallest, and these indeed may be considered a distinct row. At the posterior part of the tongue there are two groups of smaller recumbent spines directed towards the glottis. The advantage of these peculiarities of bill and tongue is evident. As the flamingo stalks along upon its long stilt-like legs, or wades in the shallow waters, it holds down its long neck towards the ground, and the peculiarly formed upper mandible is turned back downwards, and constitutes a receptacle for any small objects in the mud or water. These are retained by the lamellæ of the mandibles, assisted by the spines which fringe the fleshy tongue, and the flamingo is thus enabled to retain the small fishes, mollusca, and crustacea which constitute its food.

The incubation of the flamingo is curious. It was described by Dampier in 1683, and his account has been confirmed by subsequent travellers. Their nest is made in the marshes, and consists of earth piled up into hillocks, depressed slightly at the top. The eggs are dropped into this depression and covered by the bird's body as she stands upon her long legs resting against the hillock. These nests are sometimes dispensed with and the eggs dropped at random. Flamingoes live in marshes formed by salt lakes. They are gregarious in their habits, and when collected in large troops they present a curious resemblance to a body of soldiers standing in line. Whether they are reposing or fishing, sentinels are appointed which keep a sort of guard. If anything alarms the vedette he utters a trumpeting kind of cry, and the whole flock follow him into the air. They rarely take their repose in any other than open places. Their moult appears to be simple and ordinary, but the young birds differ much from their parents. The red or rosy plumage which covers the adult shows itself gradually, after many moults and a period of about four years. The females are smaller than the males, and the colours of the former want the purity which distinguish the latter; the young, at their departure from the nest, are white. The palmated feet of the flamingoes enable them to sustain themselves on the slimy bottoms of rivers and creeks, into which they wade as far as their long legs will allow them, and to walk thereon. As they fly in flocks they make an angle like wild geese. In walking they often apply their upper mandible to the ground, and lean on it as a point of support.

Eight species of flamingoes have been described from the temperate and tropical regions of both hemispheres. The common flamingo (*Phœnicopterus antiquorum*) is an inhabitant of Southern Europe, Africa, and Asia. It arrives in Europe in February and the following months, remaining till late in the autumn. It is a large bird, standing nearly 5 feet in height. It is of a rose colour, with wings of purple red. The common American flamingo (*Phœnicopterus ruber*, figured in Plate IV. BIRDS) is also large, with an orange-red plumage. It is found as far north as Florida. Another American species (*Phœnicopterus andinus*) is confined to the Chilian Andes.

The flesh of the flamingo is said to be tolerably good; the young are thought by some equal to partridge. The inhabitants of Provence, however, are said to throw away the flesh as fishy, and only to use the feathers as an ornament to other birds at particular entertainments. Not so the Roman epicures. Apicius has left receipts for dressing the whole bird with more than the minute accuracy of a modern cookery-book, and the "Phœnicopterus ingens" appears among the luxuries of the table in Juvenal's eleventh satire. The brains and the tongue figure as one of the favourite dishes of Heliogabalus, and the superior excellence of the latter was dwelt upon by the same Apicius, and noticed by Pliny where he records the doctrine of that "nepotum omnium altissimus gurges" (lib.

x. c. 48). Neither has it escaped the pointed pen of Martial—

"Dat mihi penna rubens nomen; sed lingua gulosis
Nostra sapit; quid si garrula lingua foret?"

FLAMIN'IAN WAY, the Roman *Via Flaminia*, the great northern road of Italy, and the first to be carried across the Apennines. It commenced at Rome, and led thence to the Adriatic at *Ariminum*, the modern Rimini. It was about 200 miles in length, and was made in 220 B.C. by Caius Flaminius. Remains of it still exist.

FLAMINI'NUS, TITUS QUINTIUS, was made consul in 198 B.C., before he was thirty years of age, and had the province of Macedonia, with the charge of continuing the war against King Philip. Meantime his brother, L. Quintius Flamininus, sailed across with a fleet and harried the eastern coast of Greece. In the following year Flamininus, after some fruitless negotiations with Philip, and after detaching the Achæans from the Macedonian alliance, marched from Phocis into Thessaly, where Philip was stationed near Larissa. The two armies met between Pheræ and Larissa, in a country broken by small hills, called Cynoscephalæ, or Dogs' Heads. After an obstinate battle the Macedonians were routed, and Philip left the field and rode off towards Tempe. The Macedonians lost 8000 killed and 5000 prisoners on that day. The king asked for a truce, which was granted by Flamininus, in order that messengers might be sent to Rome to treat of peace. The senate appointed ten legates, who, in concert with Flamininus, drew up the conditions, which were that Philip should evacuate every Grecian town and fortress beyond the limits of his paternal kingdom; that he should give up all his ships of war, reduce his military establishment, and pay 1000 talents for the expenses of the war. Flamininus was then continued in his command for another year (196 B.C.), during which, at the meeting of the Isthmian games, he caused a crier to proclaim that the Corinthians, Phocians, Locrians, Eubœans, Thessalians, Phthiotæ, Magnetæ, Perrhæbi, and Achæans were restored to their freedom: the subject of two of Wordsworth's noblest sonnets. Flamininus remained till 194 B.C. to settle the affairs of Greece. He was received in Italy with great demonstrations of joy, and the senate decreed him a triumph of three days. He was sent again to Greece from 192 to 190 as a sort of protector or viceroy. In the year 183 B.C. Flamininus was sent to Prusias, king of Bithynia, upon the ungracious mission of demanding the person of Hannibal, then, in his old age, a refugee at the court of Prusias. Hannibal took poison rather than fall into the hands of the Romans. After holding the office of augur a few years Flamininus died 174 B.C.

FLAMIN'IUS, CAIUS, tribune of the plebs B.C. 232, carried a strong agrarian law for the distribution of some newly conquered land in Gaul. Again, five years later, when prætor in Sicily, he was upon the popular side, and earned the goodwill of all by his equal justice. Throughout his career he seems like one of the Gracchi, born before his time. In consequence, he rose to the consulship in spite of violent senatorial opposition B.C. 223. After he had marched against the Gauls at the head of the army, some flaw in the ceremony of election was pretended to have been discovered, and letters of recall were sent to Flaminius. The consul, however, suspecting their tenor, left them unopened till after the battle, which proved, as he hoped, a glorious victory. Always with the admiring support of the faithful people whose cause he was almost the first to espouse, this excellent Roman became censor in 220, and built the great Flaminian circus and the Flaminian Way to Rimini. In 217, consul for the second time, chosen in a time of despair, he encountered Hannibal by Lake Trasimenus, and fell a victim to the superior strategy of that incomparable commander. Flaminius and most of his army perished, 23rd June, B.C. 217.

FLAM'STEED, JOHN, the first astronomer-royal of England, was born at Denby, near Derby, 19th August, 1646. His father, who was a maltster, gave him such an education as Derby could supply, and at an early age the youth exhibited a passion for the construction and use of astronomical instruments. At the age of fourteen he caught cold while bathing, which produced a weakness in the joints from which he never recovered. "In or before 1667 he discovered the real causes of the equation of time, and wrote a tract on the subject, which was afterwards appended by Dr. Wallis to his edition of the works of Horrox, published in 1673. In 1669 he made an astronomical communication to the Royal Society, through Oldenburg, their secretary, concealing his name under the anagram "J. Mathesin a Sole fundes," which, being transposed, gives Johannes Flamstoedius. An answer from Oldenburg, addressed to himself, showed him that he was discovered, and from that time, or rather from the date of a visit which he very shortly afterwards paid to London, he was in correspondence with many scientific men, but particularly with Sir Jonas Moore, who, in 1674, proposed to establish Flamsteed in a private observatory which he intended to build at Chelsea. In the meantime, however, the observatory of Greenwich was founded, and Flamsteed was appointed astronomer-royal.

He had at this time nothing but a sextant and clocks of Sir Jonas Moore's, and some instruments of his own. He borrowed some from the Royal Society, and, after repeatedly urging the government to provide him with an instrument fixed in the meridian, he caused a mural arc to be constructed at his own expense, which was erected in the year 1683, but proved a failure.

In the meantime he had taken orders, in 1675, having in the previous year obtained the degree of Master of Arts from Cambridge.

In 1684 his father died, and he was presented to a small living by the Lord-keeper North. Both circumstances increasing his means, he resolved to be at the expense of a new mural arc, upon an assurance from the government (which was never fulfilled) that the outlay should be repaid. This instrument was first used in September, 1689, and from that moment everything which Flamsteed did, every observation which he made, assumed a tangible and permanent form, and was available to some useful purpose. When he died the government of the day attempted to claim these instruments as public property.

The public career of Flamsteed, from this time to the end of his life, is described when we say that he collected that enormous mass of observations which furnished the first trustworthy catalogue of the fixed stars; that he made those lunar observations on which Newton depended for the illustration and verification of his lunar theory; and that he originated and practised methods of observing which may be said to form the basis of those employed at the present time. A most regrettable series of circumstances occurred in connection with the publication of Flamsteed's observations, which, though one would be glad to let them die, are of such importance as to demand a succinct account:—

Newton had been on terms of cordial intimacy with Flamsteed, but a coolness began to exist in the year 1696. When Flamsteed had completed his catalogue (having already expended £2000 more than his salary), he began to think of printing his results. But Prince George of Denmark, having heard of the extent of Flamsteed's labours, offered, in 1704, to bear the expense of printing. A committee, consisting of Newton, Sir Christopher Wren, Dr. Arbuthnot, Dr. Gregory, and Mr. Roberts, was appointed to examine Flamsteed's papers, and reported in favour of printing all of them. The superintendence of the printing, the choice of workmen, &c., was in the hands of the committee, and not in those of Flamsteed. The latter

gives the detail of various vexations to which he was subjected, and which ended (for the time) in a demand that Flamsteed should give up a manuscript copy of the catalogue of stars, which was the result of the observations, and was intended to be published at the end. This was done, with remonstrance, by Flamsteed; but the catalogue (as much of it as was ready) was sealed up, and Flamsteed declares that he understood it was to be kept sealed up until the whole of the rest was finished. It was three years before the first volume was printed; and during this time many small circumstances occurred which, if Flamsteed's colouring of the more important facts be correct, show a most determined intention on the part of the committee to give annoyance. Prince George died in 1708, before the second volume was begun, and the office of the committee was gone, but they still retained the papers in their keeping. Flamsteed, thinking nothing further about immediate publication, applied himself again to his observations. In March, 1710–11, he was surprised by being told that the seal of his catalogue had been broken, and that it was going through the press. Flamsteed immediately obtained an interview with Dr. Arbuthnot, who assured him that none of it was printed. This was not the fact; for in a few days Flamsteed himself received several printed sheets, and learned that Halley had publicly exhibited others in a coffee-house, and boasted of the pains he had taken in correcting their errors. The result was that in 1712 appeared the book known by the name of Halley, and entitled "Historia Cœlestis." Flamsteed, exceedingly irritated by the conduct of Newton and Halley, and being not naturally of a gentle temper, now kept no terms whatsoever with either. Newton had recommended the appointment of a board of visitors for the observatory (made up of members of the Royal Society), and Flamsteed was summoned to the Royal Society, 26th October, 1711, to know if his instruments (his own property) were in order, &c. Here a warm quarrel arose. Flamsteed declared to Newton that he had been robbed of his labours, and Newton replied with asperity. Flamsteed charged Newton with having broken the seal of his catalogue, and Newton replied that he had the queen's order. After this interview Flamsteed resolved to print all his observations, &c., at his own expense, and applied to Newton for the manuscript of 175 sheets of observations which were in his hands. The demand was refused, and Flamsteed commenced legal proceedings for their recovery. The additional expense caused to Flamsteed by this act of Newton was about £200.

Queen Anne died in 1714, and the Earl of Halifax, Newton's great supporter at court, in 1715. Flamsteed was now stronger with the government than his opponents; and the lords of the Treasury, at his request, surrendered all that remained of Halley's edition (about 300 copies out of 400) to his mercy. These he immediately committed to the flames, a sacrifice, as he calls it, to heavenly truth, reserving only about ninety-seven sheets of each, which had been printed as he wished, and which afterwards formed part of his first volume. From this time to his death, which took place at the end of December, 1719, he was occupied in printing his "Historia Cœlestis," which, however he did not live to finish.

FLAN'DERS, the ancient name of an extensive country of Europe, comprised between the Lower Scheldt, the North Sea, Artois, Hainault, and Brabant, and long under the rule of its own counts. The first count was Baldwin, surnamed *Bras de Fer*, who having married Judith the daughter of Charles the Bald of France, was made "mark" in 864. Though unscrupulous he was an able prince, and introduced woollen and other industries. His successors added to the wealth and power of the countship, until in the middle ages Flanders treated on equal terms with the chief European rulers. In the meantime the commercial prosperity of the cities had been constantly increasing, and they had been growing more and more independent of their counts. In 1384 the countship passed to the dukes of Burgundy, and with their territory ultimately came into the possession of the Hapsburgs. One of the royal princes of Belgium now bears the old title of Count of Flanders. The name Flanders is now borne by two provinces of Belgium known as East and West Flanders.

FLAN'DERS, EAST, a province of the kingdom of Belgium, is bounded N. by the Dutch province of Zealand, E. by the province of South Brabant and Antwerp, S. by that of Hainault, and W. by that of West Flanders. The area is 1161 square miles. The population in 1882 was 881,816. It is one of the most densely peopled parts of Europe.

The principal rivers that traverse this province are the Scheldt, the Lys, and the Dender. It is further watered by several smaller streams and brooks, all of which are tributaries of the Scheldt; and the trade of the province is facilitated by many canals, the most important of which are those from Bruges to Ghent, from Ghent to the Neuzen Canal, and the Moerwart Canal.

East Flanders is low and level. In many parts of the province there are beds of peat. The soil has been rendered extremely fertile by means of spade cultivation and an excellent manuring system. Besides the ordinary varieties of grain, potatoes, flax, hemp, hops, and tobacco are produced in great quantity. The district in the north-east of the province, between the towns of Antwerp and Ghent, is celebrated as a flax-growing country. The farms are very small. There is but little wood of large growth in the province. The chief manufactures are lace, linen, and woollen cloths, bobbinet, silk, cordage, bricks, hats, soap; and there are also cotton factories, potteries, sugar refineries, distilleries, and breweries. The capital of the province is GHENT.

FLAN'DERS, WEST, a province of Belgium, is bounded N.W. by the North Sea, N.E. by the Dutch province of Zealand, E. by the province of East Flanders, S.E. by that of Hainault, and S.S.W. and W. by France. The area is 1252 square miles. It lies between 50° 41′ and 50° 23′ N. lat., and between 2° 33′ and 3° 30′ E. lon. The population in 1883 was 691,764.

The principal rivers of the province are the Lys, the Scheldt, and the Yser; but it is watered by numerous smaller streams, and is intersected by many important canals. Its surface is flat, with sandy hills in the south and along the coast; and its soil sandy, but well cultivated and productive. The agriculture is of the most perfect kind. This province has fewer products and manufactures than East Flanders, but they are of a similar character. The capital of the province is BRUGES.

FLANK, a term of very general application in military tactics, intended to denote the side of an army or battalion from the front to the rear. Thus the *outward flank* of a division is the extreme file on the right or left; the *leading flank*, in manœuvring, is the first division or battalion which leads the attack; the *inward flank* is the first file, or the left of a division, regiment, or company; a *flank company* is a certain number of men drawn up on the right or left of a battalion; *flank files* are the first two men on the right and the last two on the left; *flank in potence* is any part of the right or left wing, formed at a right angle with the line; *to outflank* is to outstretch the enemy's forces so as successfully to attack his flank; *to turn the flank* is to pass round the side and defeat the intended operations of the enemy. In fortification the term applies to any part of a work which defends another along the outside of its parapet. Thus the *flank of the bastion* is that part which joins the face to the curtain; the *flank fichant* is that portion of the walls from which the fire is directed on the opposite bastion; the *oblique flank* is that

part of the curtain from which the face of the opposite bastion may be seen; *flank razant* is the point from which the line of defence commences; the *flank prolonged* is the extension of the flank from the angle of the epaulement to the exterior side; the *covered flank* is the platform of the casement, which lies concealed in the bastion; and the *flanks of a frontier* are the different points of a large extent of territory. *To flank an enemy*, generally speaking, is to erect a battery which may play on his works both right and left without being exposed to his fire from any quarter.

FLANNEL, a woven woollen fabric of great value for clothing on account of its lightness and warmth. In England it is chiefly manufactured at Rochdale in Lancashire and Dewsbury in Yorkshire, in Wales at Llanidloes, and Newton in Montgomery, and in Ireland at Rathdrum in Wicklow. The largest quantity is exported to Australia.

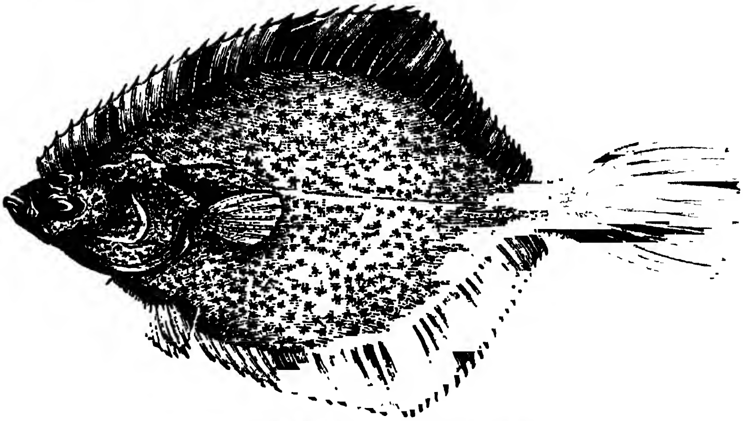
FLAT, the musical sign (♭) used to lower any note to which it is prefixed by one semitone. The double flat, ♭♭, lowers the note by two semitones. The flat is simply the letter b written in Roman type instead of the usual Gothic 𝔟, so that by its introduction in the dark ages there were two signs of the note B, and the first of these was used for the sound a semitone below the other. Thence to the general use of flats for a semitone below any note whatever was but a work of time. The origin of the flat and the changes it brought about is more fully given under ACCIDENTALS.

The interval between the two notes forming a flat (which must be notes of the same name), called above, for simplicity, a semitone, is by no means truly a semitone. That is to say, the interval from C to D♭ (a semitone) is not the same as that between D♭ and D (a flat). The ratio of the vibration-numbers of the first is 15 : 16; of the second, 128 : 135. That is to say, for every 135 of the vibrations per second of any note, 128 only must be produced in order to get a flat inflection of that note. For convenience' sake, on all keyed instruments the black note between C and D is, however, used by agreement as equally dividing that interval. It is tuned on pianofortes and organs midway between the two, and not only makes the interval C–D♭ equal to the smaller interval D♭–D, but lets the same black note also do duty for C♯ as well as for D♭.

The sharp is exactly the converse of the flat; that is to say, the interval C to C♯ has the ratio 128 : 135, just as the interval D♭ to D, while C♯ to D (the notes being of different names) is a true semitone, with ratio 15 : 16, exactly equivalent to the semitone C–D♭. The sharp raises as much as the flat depresses. In unaccompanied vocal music, and on the quartette of strings or of slide trumpets and trombones, perfectly accurate harmonies may be sung and played, and this is the reason of the exquisite beauty of finished productions with those materials. The curious accommodating power of the ear enables the ordinary conventional confusion of flat (or sharp)—that is, of the *chromatic* semitone—with the *true* semitone, to exist without making nonsense of the harmony. That is, the ear, by the context, draws a distinction between the flat and the semitone, which in pianoforte music, &c., does not actually exist. The ear, hearing an assemblage of slightly inaccurate sounds, good-naturedly takes them as what they are meant for, not as what they are. Some remarkable proofs of this are given in the article TEMPERAMENT.

The ♭ sign, called *flat* in English, is *bémol* in French and *bemolle* in Italian (*B mollis*, Latin, soft or flat B); in German it is *Be*. A key with a flattened note as tonic is in English called a *flat key*, as the key of B♭, &c., and to these the key of F, which contains one flat in its signature, is also added. In French the note or key B♭ is called *B-bémol*; in Italian, *B-bemolle*, and so for other notes or keys. But in German these notes were denoted by *es* added to their letter names; thus the G natural would in German be simply *G*, while G♭ would be *Ges*, &c. (There are two exceptions—A♭ called *As*, and B♭ called *B*, the note called in England B being in German absurdly called H.) In German also a double flat adds *eses* to the letter name of the note; D♭♭ would be *Deses*, &c.

FLAT-FISH is the name commonly given to the Pleuronectidæ, a family of fishes belonging to the order ANACANTHINI. They are distinguished among fishes by a want of bilateral symmetry. The body is strongly compressed and flat, so that both the ventral and dorsal edges are acute. The dorsal fin edges the whole back, in some genera running forward to the snout, the anal fringing the ventral edge in the same manner. Both the eyes are brought over to the side which is turned upwards when swimming or when resting on the sea-bottom. This side is usually of a brownish tint, simulating the colour of the sea-bed. The



Polar Flat-fish (*Pleuronectes glacialis*).

side turned towards the bottom is termed the "blind" side, and is usually white. There is a powerful caudal fin; the ventrals are jugular; the pectorals are usually unequal. The air-bladder is absent. The young of the flat-fishes are perfectly symmetrical, and swim in a vertical position like other fishes. "The manner in which one eye is transferred from the blind to the coloured side is subject to discussion. While some naturalists believe that the eye turning round its axis pushes its way through the yielding bones from the blind to the upper side, others hold that, as soon as the body of the fish commences to rest on one side only, the eye of that side, in its tendency to turn towards the light, carries the surrounding parts of the head with it, in fact the whole fore-part of the head is twisted towards the coloured side, which is a process of but little difficulty as long as the framework of the head is still cartilaginous" (Günther). The second explanation is the one generally received. These young symmetrical flat-fishes are found most frequently in the open sea. When adult they prefer living near the

coast, keeping to the sea-bottom. They swim with an undulating motion of their body. They are almost worldwide in their distribution, but those of the largest size occur in the temperate zone. Some enter rivers. They are carnivorous in their habits, feeding on small fish, molluscs, crustaceans, worms, &c.

Flat-fishes are of much importance in the fish-diet of England, France, and Germany, as they keep longer after death than other fish, and can therefore be safely transported to a greater distance inland. The flounders and soles come into shallow water, and on the flat sands of the Solway Frith are often taken by the women and children wading over the sandbanks, who, when the fish is felt under the naked foot, press it down until it can be grasped behind the head and transferred to a basket. Greater quantities are captured in weirs or trawl-nets, and the turbot and holibut, which inhabit deeper water, are mostly taken by lines and hooks baited with herrings, pilchards, smelts, lobworms, molluscs, &c.

Over forty genera of flat-fishes have been established. The most interesting are—Pleuronectes (PLAICE, DAB, SMEAR-DAB, FLOUNDER), Hippoglossus (HOLIBUT), Rhombus (TURBOT, BRILL, WHIFF), Phrynorhombus (TOP-KNOT), Arnoglossus (SCALD-FISH), Solea (SOLE).

FLAT'ULENCE, or wind in the stomach or intestines, is one of the commonest symptoms of dyspepsia. It is caused by the undue generation of gases, usually derived from undigested food which is undergoing a process of fermentation or even putrefaction, but sometimes formed by other means when the digestive organs are empty. It often comes on when people are prevented from taking their meals at the customary hour, and it is very common in cases of hysteria, hypochondriasis, and other forms of nervous debility. Some forms of food are specially liable to cause this complaint; sugar and starchy foods, fruit and vegetables, warm liquids, especially tea and soup, and malt liquors, being all apt to give rise to flatulence where the digestion is weak.

Where it arises from want of tone in the digestive organs much care must be taken with the diet. The articles of food likely to cause flatulence must be avoided or only partaken of very sparingly. Meals should be regular, moderate in quantity, and the food well masticated, liquids being taken only in small quantities at the close of the meal.

For the relief of the symptoms of this complaint many remedies are available, such as sal-volatile, of which from thirty to forty drops may be taken in a little water; the oils of cajuput, cloves, or carraway, of which the dose is three drops on a piece of sugar; the compound spirits of horse-radish in quantities of half a teaspoonful in a little water, and the different forms of ginger, mint, anise, camphor, cascarilla, &c. Charcoal in doses of five to ten grains is an excellent preventive of this affection. Where flatulence prevails during the taking of food the charcoal should be taken before meals, but where it arises during digestion it should be taken shortly afterwards. Other remedies are found in the carbonate of bismuth, sulphocarbolate of soda, sulphurous acid, dilute hydrochloric acid, and asafœtida.

Where this complaint arises from hysteria, &c., alkalies and bitters are chiefly to be depended on for its treatment. See also CARMINATIVES and COLIC.

FLA'VIAN EMPERORS, the successors of the Cæsars properly so called. Nero, who was the last Cæsar descended from the great Julius, was succeeded by Galba (68), whom Otho and Vitellius followed in one terrible year of anarchy. The state was then saved by the honest admirable Sabine general, Vespasian (69), whose name, Titus Flavius Vespasianus, gave the gentile name of Flavian to the new dynasty. Vespasian's son, Titus, followed; and another son, Domitian, concluded the dynasty. With the assassination of Domitian (96), the twelfth emperor counting from Julius Cæsar (the last, therefore, of the arbitrarily named group of "the Twelve Cæsars"), the Flavian emperors end, and the epoch of the "five good emperors," from Nerva to Marcus Aurelius, begins. The Cæsars proper were Romans, but the Flavians and Nerva were Italians, while Trajan, the successor of Nerva, was a Spaniard. Thus rapidly did the wide empire of Rome gather in all that was best wherever found, abandoning the exclusiveness which once pretended to govern the world by the citizens of one town.

FLA'VIN, a yellow dye, used as a substitute for quercitron (*Quercus Nigra*). It is a glucoside identical with quercitrin, and splits up into quercetin and glucose when acted on by dilute sulphuric or hydrochloric acid.

FLAX (*Linum usitatissimum*) is an annual plant belonging to the order LINEÆ. It has been cultivated from time immemorial for its textile fibres, which are spun into thread and woven into linen cloth. It has a green stem, from 1½ foot to 3 feet high, and a blue flower, which is succeeded by a capsule containing ten flat oblong seeds

Flax Plant (*Linum usitatissimum*). Fibres of Flax, highly magnified.

of a brown colour, from which the drying fixed oil called linseed is expressed, which is so extensively used in manufactures and printing. The remainder of the crushed mass is the well-known linseed or oil cake so much used in feeding cattle. There are several varieties of flax cultivated. The best seed comes from Riga and from Holland. There is a very fine long variety which is cultivated in the neighbourhood of Courtrai, in Flanders.

The soil best adapted to the growth of flax is a deep rich loam in which there is much vegetable mould. It thrives well in the rich alluvial land of Zealand and the polders. It is also raised with great success in the light sands of Flanders, but much more careful tillage and manuring are required. The land on which flax is sown must be very free from weeds, the weeding of this crop being a very important part of the expense of cultivation.

In southern climates flax is sown before winter, because too great heat would destroy it. It is then pulled before the heat of summer. In northern climates the frost, and especially the alternation of frost and thaw in the early part of spring, would cause the flax to perish; it is consequently sown as early in spring as may be, so as to avoid the effect of hard frost.

When the flax is full grown the pulling begins, which is done carefully by small handfuls at a time. These are laid upon the ground to dry, two and two obliquely across each other. Soon after this they are collected in larger bundles and placed with the root end on the ground, the bundles being slightly tied near the seed end; the other end is spread out that the air may have access and the rain may not damage the flax. When sufficiently dry they are tied more firmly in the middle, and stacked in long narrow stacks on the ground. This is the method adopted by those who defer the steeping till another season. Some carry the flax as soon as it is dry under a shed, and take off the capsules with the seed by *rippling*, which is drawing the flax through an iron comb fixed in a block of wood. The flax is then immediately steeped; but the most experienced flax-steepers defer this operation till the next season. In this case it is put in barns, and the seed is beat out at leisure in winter.

Steeping, or *retting*, the flax is a very important process. The object is to separate the fibres from the woody part of the stem, and from the small soft cells between these and on the outside. The usual mode of steeping is to place the bundles of flax horizontally in shallow pools or ditches of stagnant water, keeping them under water by means of poles or boards with stones or weights laid upon them. The method adopted by the steepers of Courtrai, where steeping flax is a distinct trade, is different. The bundles of flax are placed alternately with the seed end of the one to the root end of the other, the latter projecting a few inches; as many of these are tied together near both ends as form a thick bundle about a foot in diameter, and these are placed in an oblong wooden frame. The frame is sunk in the river Lys low enough to keep all the flax under water, and is kept there till the steeping is effected. The bundles are now untied, and the flax is spread evenly in rows slightly overlapping each other on a piece of clean smooth grass which has been mown or grazed off close. It is occasionally turned over, and is allowed to remain spread out upon the grass till the woody part becomes brittle. It is then taken up, and as soon as it is quite dry it is tied up again in bundles and carried into the barn. Numerous ingenious processes have been invented for increasing the certainty and rapidity of steeping the flax, but for the finer kinds the old natural method is still held in favour.

In the domestic manufactures the flax is broken or scutched at home when the weather prevents outdoor work; but the invention of improved machinery, and the erection of scutching mills, has considerably altered this branch of the industry, except on the Continent, where manual labour still holds its own, though scutch-mills are common in Belgium. The common brake consists of four wooden swords fixed in a frame, and another frame with three swords, which play in the interstices of the first by means of a joint at one end. The flax is taken in the left hand and placed between the two frames, and the upper frame is pushed down briskly upon it. It breaks the flax in four places, and by moving the left hand, and rapidly repeating the strokes with the right, the whole handful is soon broken. It is then scutched by means of a board set upright in a block of wood so as to stand steady, in which is a horizontal slit about 3 feet from the ground, the edge of which is thin. The broken flax, held in handfuls in the left hand, is inserted in this slit, so as to project to the right, and a flat wooden sword of a peculiar shape is held in the right hand; with this the flax is repeatedly struck close to the upright board, while the part which lies in the slit is continually changed by a motion of the left hand. This operation beats off all the pieces of the wood which still adhere to the fibre, without breaking it, and after a short time the flax is cleared of it and fit to be heckled.

Flax is found in every quarter of the globe, and has been cultivated for its fibrous stalk from the earliest period. Bundles of prepared flax have been found in the Swiss lake-dwellings, showing that in prehistoric times the value of flax was well known; this flax was probably made from another species (*Linum angustifolium*). The preparation of flax is depicted on the tombs of ancient Egypt, and there are constant references in the oldest books of the Bible to flax and fine linen.

England has never grown a sufficient quantity of flax for its own use, although it has often been attempted to give encouragement to the cultivation by public rewards or bounties. It is, however, extensively grown in Ireland, especially in Ulster, but the number of acres devoted to it varies very considerably. In 1864 it was 301,693 acres; in 1883, only 95,935 acres. In England in the same year 4158 acres were so employed, and in Scotland 50 acres.

The imports from abroad of course vary to some extent according to the British crop. The quantity received in 1871 was 2,597,915 cwts.; in 1876, 1,404,661 cwts.; in 1882, 1,966,969 cwts.; and in 1883, 1,546,931 cwts. The following were the countries from which the largest supplies were imported in the latter year:—

	Cwts.		Value.
Russia, ...	1,086,190	...	£1,631,563
Germany, . . .	71,066	...	111,555
Holland, ...	75,808	...	215,327
Belgium, ...	267,187	...	832,899
Other countries, .	46,680	...	85,374
	1,546,931		£2,876,718

FLAX, NEW ZEALAND, a perennial plant belonging to the order LILIACEÆ, and quite different from common flax, is a native of New Zealand and Norfolk Island. From time to time it has been imported into Britain for making ropes and twine, but the presence of a viscid gummy matter in the leaves renders the preparation too costly. The New Zealanders convert it into dresses, mats, and cloth. Its leaves are from 2 to 6 feet long and from 1 to 3 inches broad. The fibre is very fine and strong, and to obtain it the leaves are cut when they have attained their full size, and afterwards are macerated for a few days in water. The flowers are numerous and of a yellow colour, from which the natives prepare a sweet beverage; they also use the roots medicinally as a substitute for sarsaparilla. An interesting account is given of this plant by Captain Cook, who visited New Zealand (1769–70) during his first voyage:—"There is, however, a plant (the New Zealand flax) that serves the inhabitants instead of hemp and flax, which excels all that are put to the same purposes in other countries. Of the leaves, with very little preparation, they make all their common apparel; and of these they make also their strings, lines, and cordage for every purpose, which are so much stronger than anything we can make with hemp that they will not bear a comparison. From the same plant, by another preparation, they draw long, slender fibres, which shine like silk and are as white as snow; of these, which are also surprisingly strong, the finer clothes are made; and of the leaves, without any other preparation than splitting them into proper breadth and tying the strips together, they make their fishing-nets, some of which are of an enormous size."

FLAX-MILL, a factory where the fibrous material of flax is spun into yarn, preparatory to being woven

into linen, cambric, damask, or muslin in power-loom weaving factories, or by workers at their own homes with handlooms. Belfast and the province of Ulster are the principal seats of the linen trade in the United Kingdom, and there accordingly are found the largest and best flax-mills. In Ulster alone there are 130 of these mills, giving employment to upwards of 50,000 persons. There are a few flax-mills in England and Scotland, but the trade appears naturally to localize itself in North Ireland, as the cotton trade does in Lancashire. In general appearance and arrangement a flax-mill is somewhat similar to a cotton-mill, being built several storeys high, and each floor consisting of one large room only, with windows on all sides. The heavy machinery used in cleaning and preparing the flax is generally placed on the ground-floor; the spinning is carried on in the first, second, and third floors; and the reeling, drying, and bundling of the yarn in the topmost storey. All the machinery is driven by steam or water power. The term *flax-mill* is also used in Ireland when speaking of the places in which the flax is scutched.

The counties in which the largest number of factories is found are—Antrim, Down, and Armagh, in Ireland; Fife, Forfar, and Perth, in Scotland; and Yorkshire and Lancashire in England. The following table, compiled from the latest official returns, gives the most interesting particulars with regard to flax factories:—

SUMMARY OF FLAX FACTORIES.

		'otal Number of Doubling Spindles.	T l Number of wer-looms.	Number of Persons Employed.		Total Males and Females.
England and Wales, . .	190,808	28,439	4,081	4,812	10,176	14,988
Scotland, . .	265,263	18,495	16,756	9,987	27,489	37,476
Ireland, . .	808,695	18,048	19,611	17,036	39,306	56,342
Grand Total,	1,264,766	64,982	40,448	31,835	76,971	108,806

Full details of the imports and exports of linen and other goods made from flax are given in the article LINEN MANUFACTURES.

FLAX'MAN, JOHN, R.A., was born at York, 6th July, 1755, but was brought while a child to London. His father kept a plaster-cast shop in the Strand, and this was Flaxman's first school of art. He was a sickly boy, and was never strong as a man. In his twelfth year he gained a silver palette from the Society of Arts. He won another prize the following year, then entered the Royal Academy as student, and in his fourteenth year gained a silver medal. This was the first year of the opening of the schools of the academy, 1769. He competed in the following year for the gold medal, but in this he failed. While pursuing his art under the usual difficulties of the aspiring student, he worked for Mr. Wedgwood, and improved the manufacture of pottery in England so as to immensely increase the trade and obtain it a world-wide reputation, of which it feels the advantages and benefits to this day. In 1782 he married Ann Denman, and established himself in a house in Wardour Street. By this time he had acquired some reputation as a sculptor, chiefly for sepulchral monuments, but he had also executed a group of "Venus and Cupid," which was much admired. He went with his wife to Italy in 1787. In Rome he executed a colossal group of the "Fury of Athamas" from Ovid, for Lord Bristol, then bishop of Derry. But the work which he executed in Rome that has done most for Flaxman's reputation is the series of designs in outline from Homer, Æschylus, and Dante; the "Iliad" and "Odyssey" for Mrs. Hare Naylor; the "Tragedies of Æschylus" for the Countess Spencer; and the "Dante" for Mr. Hope. They were all well engraved in outline by Thomas Piroli, and published at Rome in 1793. He returned to England in 1794, was elected an associate of the academy in 1797, a member in 1800, and professor of sculpture in 1810, being the first to occupy that office in England. In 1820 he lost his wife, to whom he was devotedly attached. They never had any family, and on the 7th of December, 1826, he ended his now solitary life. He was buried at St. Giles'. Flaxman was as remarkable for the simplicity and piety of his life as for his industry. The ten lectures delivered by him to the students of the Royal Academy have been twice published, with some additional papers furnished by his executrix, Miss Maria Denman. They contain much useful information and many fine sentiments, but make no pretensions to literary style. Among the most celebrated of his works are—the monument to Lord Mansfield in Westminster Abbey; the statue of Sir Joshua Reynolds in St. Paul's Cathedral; and the colossal group of "Satan and the Archangel Michael," made for the Earl of Egremont. His collection of plaster casts from his own original models in clay, about 140 in number, many of which were retouched after they were cast, were given by Miss Denman to the council of University College, London, where they have been arranged under the dome as the "Flaxman Gallery."

FLEA (cognate to *flee*, *fly*) is the name applied to certain wingless insects belonging to the family Pulicidæ, which live as external parasites on many animals. The exact position of the family Pulicidæ in a classification of insects is hard to determine; the best authorities, however, regard it as falling under the order DIPTERA, but sufficiently distinct to be made the type of a special suborder, Aphaniptera. The flea *par excellence* is the *Pulex irritans*, the species which makes man its host. This species may be taken as the type of the family. The flea has a much compressed body; the thorax is not very distinct from the rest of the body, and has its three segments separate. Wings are altogether absent; they are represented probably by four little scales, one on each side of the mesothorax and metathorax. In the structure of the mouth the fleas, while presenting a general agreement with the other Diptera, have peculiar modifications in accordance with their blood-sucking habits. The upper lip (*labrum*) is quite rudimentary. The mandibles are represented by two elongated setæ, the edges of which are serrated; the tongue (*lingua*) is of the same length, but more slender. These setæ when united, and inclosing the tongue between them, form the piercing lancet-like instrument with which the insect punctures the skin. When not in use the mandibles are protected by a sheath formed by the palps of the lower lip (*labium*). The second pair of jaws (*maxillæ*) are small, but each bears a well-developed palp of four joints; these palps, from their size and position, might be mistaken for antennæ. These latter organs are very small, four-jointed, and generally concealed in little cavities behind the eyes, which are small and round. As we know to our chagrin fleas are endowed with extraordinary powers of leaping, the legs being very long and powerful. In the "Clouds" of Aristophanes, Socrates shows his "subtlety of thought" by contriving to measure the leap of a flea. In modern days the great muscular power of these insects has been turned to account by the exhibitors of "industrious fleas."

Fleas undergo complete transformations. The female lays a number of oval eggs of pure white colour, selecting frequently a hearth-rug, carpet, or chair-cushion; at other times she deposits them in dusty cracks in the floor. The larvæ are long, slender, worm-like, footless grubs, which when full grown spin and inclose themselves in silken

cocoons, in which they undergo the change to the pupal condition. The pupa is inactive. Although sufficiently numerous in this country, particularly in dirty houses and among people of dirty habits, little idea of the multitudinous hosts in which they swarm in hotter parts of the globe can be formed, until the traveller makes their acquaintance in favoured localities.

Besides the species which attacks man many other species are known, each with its own peculiar host. Among these may be mentioned the flea of the dog (*Pulex canis*), of the cat (*Pulex felis*), of the common fowl (*Pulex gallinæ*), and of the badger (*Pulex melis*), the largest British species, being the eighth of an inch in length. In a flea found on the mole no trace of eyes can be found. The largest species known infests the Echidna or porcupine ant-eater of Australia. A flea inhabiting South America and the West Indies is generically separated from the rest of the family under the name *Sarcopsylla penetrans*. This is the CHIGOE or jigger. It is a great pest, from its habit of burrowing into the naked feet of men. The aromatic odours of some plants of the order Compositæ are peculiarly offensive to fleas. Wormwood is much extolled by old Thomas Tusser as a remedy against these pests.

FLECHE, a breastwork consisting of two faces, which form with one another a salient angle. It is constructed on the exterior of the glacis of a fortress, in order to defend by its fire the ground before the bastion and ravelin.

FLÈCHE, LA, a town of France, in the department of Sarthe, situated in a beautiful valley on the Loire, 23 miles S.W. of Le Mans. It is an old but well-built place, with a castle, built by Henry IV. in 1603, and afterwards given by him to the Jesuits for a college, which became celebrated, and is now a military academy. The population is 8862. Previously to the tenth century it was called *Fissa;* it owes its present name to the spire (*flèche*), placed in the twelfth century on the tower of St. Thomas's Church. One of the greatest of Scotch philosophers, David Hume, resided at La Flèche in 1735 and 1736, and here composed the greater portion of his earliest work, the "Treatise on Human Nature." La Flèche was the birthplace of Descartes.

FLECK'NOE, RICHARD, might rest in the obscurity to which his dullness entitles him if it were not that he has been immortalized as the shadowy hero of Dryden's wonderful satire "MacFlecknoe," prototype and model of Pope's "Dunciad." Shadwell had written bitterly and coarsely against the "glorious John," and Dryden pilloried him in this poem, wherein Richard Flecknoe, who

> "In prose and verse was owned without dispute
> Through all the realms of nonsense absolute,"

nominates Shadwell as his successor. Shadwell is crowned with poppies as MacFlecknoe (*i.e.* son of Flecknoe), owls flying round him, and receives Flecknoe's blessing, and the dying advice given as the departing monarch,

> "Sinking, left his drugget robe behind,
> Borne upwards by a subterranean wind,"

in an audaciously sublime parody.

Richard Flecknoe was born about 1610, and died 1678. He was an Irish Roman Catholic priest, but came to London and left his profession for that of literature. He was not quite fairly treated by Dryden, and from time to time apologists arise who are able to give quotations from Flecknoe of quite average excellence. Nevertheless, as was said above, his only permanent interest arises from Dryden's lash being so unmercifully laid upon him. The same may be said of Shadwell, at whom of course Dryden aimed rather than at Flecknoe.

FLEET MARRIAGES. Before the passing of the Marriage Act, 26 Geo. II. c. 33, there was no necessity in England for any religious ceremony in the performance of the marriage rite, which might be contracted by mere verbal consent before a clergyman. The chapels at the Savoy, Mayfair, and the Fleet Prison became notorious for clandestine marriages from 1613 to 1674. In the latter year the two former places were closed by the ecclesiastical commissioners against such practices, and the Fleet at once became the favourite resort for those who desired to effect a secret marriage. The persons who celebrated these marriages were clergymen, who had been consigned for debt to the Fleet, and, having lost all sense of the dignity of their calling, they employed touters to bring to them such persons as required their offices. The best idea of this public nuisance may be gathered from Tennant's description of the neighbourhood of the Fleet in his time. He says—"In walking along the street in my youth on the side next the prison, I have often been tempted by the question, 'Sir, will you please to walk in and be married?' Along this most lawless space was hung up the frequent sign of a male and female hand conjoined, with 'Marriages performed within' written beneath. A dirty fellow invited you in. The parson was seen walking before his shop, a squalid, dirty figure, clad in a tattered plaid nightgown, with a fiery face, and ready to couple you for a dram of gin or a pipe of tobacco." ("London," p. 193.) Every species of enormity was practised while this iniquitous traffic was at its height; young men were decoyed into a union with the most infamous characters, young ladies compelled to marry against their will, many persons were married without any intention of keeping the bond, and sailors especially were made victims during their drunken freaks. Sometimes respectable people were married here for reasons of their own, as, for instance, the Hon. Henry Fox to the daughter of the Duke of Richmond. The collection of registers kept by the various parties who officiated was bought by the government in 1821, and amounted to nearly 300 large ones, besides upwards of 1000 smaller books, called pocket-books. The Act above referred to put an end to the practice by declaring that all marriages solemnized in England otherwise than in a church or public chapel, unless by special license, should be utterly void.

FLEET PRISON, the name of a metropolitan prison now abolished, so called from its being situated by the side of the river Fleet, which is now covered over. It was the prison to which persons were committed by the ecclesiastical courts, courts of Equity, Exchequer, and Common Pleas. It was burnt by Wat Tyler in the reign of Richard II., and was a place of detention for many of the victims of Mary's persecution.

The Fleet Prison was abolished by the 5 & 6 Vict. c. 22, which established the Queen's Prison (formerly the Queen's Bench Prison) as the only prison for debtors, bankrupts, and other persons who might formerly have been imprisoned in the Queen's Bench Prison, the Fleet Prison, or the Marshalsea Prison. The building was pulled down in 1845, and the site is now occupied by the London, Chatham, and Dover Railway. The river derived its name from the rapidity of its stream.

FLEET'WOOD, a seaport and watering-place of England, in the county of Lancashire, 228 miles from London by the Preston and Wyre Railway. It stands at the mouth of the estuary of the Wyre. The town, harbour, docks, warehouses, and pier were planned by Sir Hesketh Fleetwood, Bart., about the year 1836, on ground which before that time was little better than a rabbit warren. A large hotel, shore lighthouses, and other buildings have been erected, and docks and additional works constructed with the assistance of the London and North-western, and the Lancashire and Yorkshire Railway companies. A dock, 1020 feet long and 400 feet wide, was completed in 1877. It was expected that Fleetwood would attract a large amount of foreign trade as well as of the traffic to and

from Belfast, Londonderry, Drogheda, and other Irish ports; but Liverpool still commands nearly all the foreign trade and most of the Irish traffic, although there is daily communication between Fleetwood and Belfast. During the summer months there is also daily communication with the Isle of Man. Over eighty sloops belonging to the port are engaged in fishing. The town has a good share of summer visitors, for whom excellent accommodation exists. There are several places of worship, and a Whitworth Institute. The number of vessels registered as belonging to the port in 1884 was 150 (20,000 tons). The entries and clearances average 1200 (370,000 tons) per annum.

FLEM'ISH LANGUAGE. This is interesting as a variety of the Frisian Low German dialect, nearly akin to the basis of our own language. It still exists in a considerable part of Belgium and the nearest provinces of Holland almost unaltered. It flourishes in East and West Flanders, Antwerp, and North Brabant. Documents over ten centuries old are perfectly clear to the men of to-day. In 1618 the Synod of Dort decreed the translation of the Bible, and as with ourselves this translation (of about the same date with our own) has fixed the literary form of the language in a very great degree. In the seventeenth century the poet Cats wrote in Flemish, and his works have ever since been the food of the people. They have been partly translated into English (London, 1859), and retain sufficient of their original flavour to show them to be poems of great merit. The powerful novels of Hendrik Conscience have in our own day revived the glories of Flemish, and have received the honour of translation into several languages, including English. Partly owing to the influence of this writer and of the historian Blommaert, the Belgian government in certain provinces has permitted Flemish to be restored as the national language since 1841, though French is still the language of the bulk of the educated community.

FLEM'ISH SCHOOL (of painting). The principal masters of the early Flemish school were the two Van Eycks (about 1370–1440), inventors of oil painting; Roger Van der Weyden (1400–64), who invented canvas-painting, instead of the previously universal panel-painting, for easel pictures (he also was the first to go to Italy in search of art—a plan in his case good, but fatal to those who followed him); Hans Memling (1430–95), pupil of Roger and Schongauer, the best German master of the fifteenth century. This may be called the Bruges school, and Memling must be taken as its culminating point. A Dutch school split off from Bruges in the fifteenth century [see DUTCH SCHOOL]; and at the close of the century a very fine school succeeded at Antwerp to the declining glories of Bruges, and the leader of it was the remarkable Quintin Matsys (1466–1531). Most unfortunately painters like Jan Gossart of Maubeuge, commonly called therefore Mabuse (1470–1532), who at first worked with Matsys, thought to better their art by studying in Italy; and by introducing Italian elements, quite discordant, proved the ruin of what might have been a fine characteristic national school. Michael Van Coxie and Breughel are fine painters of this period, being less contaminated than the rest by the Italian manner.

But a completely new departure was made at the close of the seventeenth century by the magnificent colourist Rubens (1577–1640), who while as realistic as the Van Eycks and as consummate in mastery of the technical materials of the palette, and by consequence as luminous in his tones as they, added the fire of an unrivalled vigour, the greatest power over colour yet attained—even excelling that of his masters the Venetians—a supreme command of the grand quality called breadth, and a fine perception of balance of tone. Snyders (1579–1657) was a worthy contemporary, confining himself chiefly to animals, and often working with Rubens and with Jordaens. The school of students of Rubens was one of the grandest ever known. The leader was the courtly Vandyck, dear to us from his pictures of Charles I. and his court, and, nearer to Rubens in style, the vigorous Jordaens. There were also many others of considerable merit. Outside the school of Rubens in style, although as a matter of fact partly taught by him, is the great Teniers (1610–90), chief of *genre* painters. Teniers had a small following, but has no rival nor companion. More in the school of Vandyck, but very far removed, is the arch-flatterer whom we know as Sir Peter Lely (1618–80), whose real name was Peter Van der Faes; he succeeded Vandyck as the favourite court painter in England, and has preserved to us in striking contrast the presentments of the rugged grandeur of Oliver Cromwell and of the lavishly displayed charms of the frail beauties of the court of the Restoration.

Flemish art lost all distinctive peculiarity after the seventeenth century, but in our own day it has revived in a school preserving much of the faithful naturalism of the early Flemings. The leader of this school was the excellent artist Baron Leys (died 1869).

FLENS'BURG, an important town of Prussia, at the southern extremity of an arm of the Baltic, and in the centre of Schleswig. It has 30,956 inhabitants. It is pleasant and well built, inclosed by an old wall and ditch, outside of which there are three suburbs. The streets are well paved and lighted. Flensburg has a school of navigation, a college, an orphan asylum, several schools, an exchange, a theatre, and a house of correction. It has manufactories of brandy, refined sugar, tobacco, tiles, sail-cloth, soap and tallow, paper, &c. There are shipbuilding yards, and the people of the town are owners of between 200 and 300 vessels. There is a good harbour, deep enough for large ships, but the entrance is difficult. The trade is considerable, and the exports are brandy, corn, hides and skins, soap, tallow, fish, and the well-known tiles made in the immediate vicinity, of which large quantities are shipped. Flensburg is said to have been named from the knight Flenes, the reputed founder of the town in the twelfth century.

FLESH of animals forms an important part of the food of most men. The term practically means muscular tissue regarded as food, and its double characters of living muscle and eatable flesh are considered under the respective headings MUSCLE and FOOD.

FLETCHER, ANDREW, of Saltoun, a celebrated Scottish patriot, was the son of Sir Robert Fletcher of Saltoun, in East Lothian, and was born in 1653. He was descended from the Bruce on his mother's side. Andrew Fletcher's early education was superintended by Gilbert Burnet, afterwards the celebrated bishop of Salisbury, at that time parish minister of Saltoun. After travelling for a time on the Continent, Fletcher on his return home obtained a seat in the Scottish Parliament as commissioner or member for his native county, and soon became distinguished as one of the foremost opponents of the government of the Duke of York (afterwards James II.) After some time he withdrew to Holland, on which he was summoned before the Lords of the Council, and, when he did not make his appearance, was outlawed and his estate confiscated. He afterwards came to England and joined in the Rye House and other plots (1683), and eventually in the rebellion of the Duke of Monmouth (1685); but having shot the Mayor of Lyme in a quarrel he was forced to leave the country precipitately before the battle of Sedgmoor. He then proceeded to Spain, and afterwards to Hungary, where he took part in some military operations against the Turks, and distinguished himself by his gallantry. When the scheme of the English Revolution began to be projected he went to Holland to take a part;

he came over to England with the Prince of Orange in 1688, recovered possession of his estate, and again sat as representative for his native county. He soon, however, became as determined an opponent of the government of King William as he had formerly been of that of Charles II. His last exertions as a public man were directed against the scheme of the union of the two kingdoms. In fact, as Macaulay finely says ("History," xxiv.), "Fletcher's whole soul was possessed by a sore, jealous, punctilious patriotism. His heart was ulcerated by the thought of the poverty, the feebleness, the political insignificance of Scotland, and of the indignities which she had suffered at the hand of her powerful and opulent neighbour." He sought out Paterson, the famous projector (founder of the Bank of England), with a grand scheme for colonizing the Isthmus of Darien with Scotchmen, who, thus placed midway between Scotland and India, would construct works to facilitate the passage of goods from the Atlantic to the Pacific, and so hold the key of the world's commerce. The disfavour, if not opposition, of William, probably fully justified by the statesmanship of the time, and the inherent difficulties of the scheme, crushed it into utter ruin, supported though it was in a manner most significant considering the poverty of Scotland. [See DARIEN SCHEME.] This last blow assured Fletcher of the faithlessness of England. When he talked of Scotland's wrongs his dark meagre face took its sternest expression and his eyes flashed fire. He died in London in 1716, in a gloomy resignation at what he considered the fatal Act of Union—an Act which we now consider one of the most beneficent ever passed. He was the author of numerous tracts, all of which were reprinted at London in an octavo volume in 1737, under the title of "The Political Works of Andrew Fletcher, Esquire."

FLETCHER, GILES and **PHINEAS**, were the sons of Dr. Giles Fletcher, and cousins of John Fletcher the dramatist.

GILES, the elder, was born about 1580, was educated at Trinity College, Cambridge, and died at his living of Alderton, in Suffolk, in 1623. The single poem which he has left, "Christ's Victory in Heaven, Christ's Triumph on Earth, Christ's Triumph over Death, Christ's Triumph after Death," though now seldom read, is of a high order of merit.

PHINEAS FLETCHER, younger brother of Giles, was born about 1584, and admitted scholar of King's College, Cambridge, in 1600. In 1621 he was presented to the living of Hilgay, in Norfolk, where he died about 1660. Though he wrote other works, Latin and English, the only one by which he is now known is "The Purple Island, or the Isle of Man," a description of the human soul and body, but especially the latter, much in the style of "Christ's Triumph."

The two Fletchers are the more remarkable as having tended to form the style of Milton's poetry, as may be seen by anyone well acquainted with both.

FLETCHER, JOHN, was born in 1579, and was the son of the Rev. Dr. Fletcher, afterwards bishop of Bristol. He was educated at Cambridge with his friend, Francis Beaumont. For an account of his works and his literary connection with Beaumont see BEAUMONT. He was carried off by the plague in 1625.

FLEUR-DE-LIS, or according to Shakspeare *Fleur-de-luce*, a term of blazonry for the flower which resembles an iris, and which previously to the French Revolution was borne first semée, and then three, as representing semée, in the arms of France. It seems highly probable that the following is the right solution of what as it stands at present is an absurdity, as the design is not of a lily at all. Louis VII. of France (reigned 1137–80) finding certain old heraldic devices on the French royal flag whose meaning was then forgotten, read them as iris-blooms, and formalized them into the well-known symbol, called after him *fleurs-de-Louis*, and afterwards corrupted by folk-etymology into *fleurs-de-lis* (lily flowers). He scattered them all over the flag. Charles VI. in 1365 reduced their number to that of the Trinity. But the antiquary Givillim said that the correct reading of the ancient device was not, as Louis had supposed, flowers, but toads. It was this remark which caused *Crapaud* for centuries to be the nickname of Frenchmen. But now opinions waver, for many hold that the device means flying bees, a number of such ornaments being found in the tomb of Childeric when it was opened in 1653. Napoleon adopted the golden bees instead of the "lilies" of the kings. More recently still it has been shown that probably Childeric's ornaments were not attached to the mantle, and therefore the emblem still awaits authoritative explanation. Its origin and history have been variously stated by the French antiquaries. Upon crowns and the tops of sceptres the *fleur-de-lis* was used by other nations as well as France from a very early period, and it is still borne upon some portion of the shield of many Scotch and English families.

FLEURY, CARDINAL (ANDRÉ HERCULE DE FLEURY), was born in 1653 at Lodève, in Languedoc, studied at Paris in the college of the Jesuits, was afterwards made almoner to the queen consort of Louis XIV., and in 1699 bishop of Fréjus, which see he resigned in 1715 on account of ill health. Louis XIV. appointed him preceptor to his grandson, afterwards Louis XV., who became greatly attached to him. After the death of the regent D'Orleans in 1723 Fleury became prime minister, in which office he continued for seventeen years, till the time of his death. The period of his administration was the happiest part of the reign of Louis XV. Fleury was honest, economical, disinterested, a friend to peace, and a patron of learning. He was obliged, against his inclination, to take a part in the war of the Polish succession in 1733. In 1741 Cardinal Fleury was driven into another war, that of the Austrian succession, of which he did not live to see the end. He died in 1743, at eighty-nine years of age.

FLEURY, ABBÉ CLAUDE, was born at Paris in 1640, and died in 1723, aged eighty-three years. He practised at the bar for nine years, after which he entered the church, and thenceforward devoted himself to theological study. In 1674 he was appointed tutor to the Prince de Conti, whom Louis XIV. educated with his son the Dauphin, and afterwards to the other royal princes. In 1696 he succeeded Labruyère as member of the French Academy, and in 1707 the king bestowed on him the priory of Argenteuil, in the diocese of Paris. This grant was very acceptable to Fleury, as it afforded him a comfortable retirement for the prosecution of his studies. After the death of Louis XIV. (1716), the regent, the Duc d'Orleans, nominated Fleury confessor to the young king, Louis XV., a post which he held till 1722. He died, 14th July, 1723.

Fleury commenced his literary career with his "Histoire du Droit François" (1674). He afterwards published "Institution au Droit Ecclésiastique," "Catéchisme Historique," and other works. But the most valuable of his works, and that which has established his reputation as a first-rate writer, is the "Histoire Ecclésiastique" (twenty vols. 4to). It begins with the establishment of Christianity, and extends to the year 1514. It was continued till the year 1598 by Fabre, of the Oratoire, in sixteen vols. 4to. Fleury's "Ecclesiastical History" is translated into English.

FLEXIBILITY is a property of bodies by which they yield transversely on the application of some power. This property is distinct from elasticity, as it does not necessarily follow that the bodies acted on recover their original figures when the power is removed.

FLEX'ORS are those muscles which are opposed to *extensors*, the flexors bending the limbs or the extremities at their joints, the extensors straightening them.

FLEX'URE (of beams and of columns). Columns for supporting weights or other pressures, when their lengths are considerable in comparison with their diameters, give way to loads which exceed their strength, not by direct crushing, as short blocks would do, but by bending sideways and breaking across after the manner of a beam. There does not yet exist any exact and complete mathematical theory of this phenomenon, but its laws have been expressed by approximate rules deduced from experiment, and near enough to the truth for practical purposes. Those rules are founded mainly on the principle that the weakening effect of length upon a column is directly as the square of the length, and inversely as the square of the diameter of the column measured in that direction in which it is most easily bent. This may be otherwise expressed by saying that the straining effect of a load P upon a column of the length l and diameter d is as great as that of a load $P\left(1+\frac{al^2}{d^2}\right)$ upon a short block of the same material, a being a coefficient deduced from experiment, and depending on the nature of the material and on the form of the column and the mode of fixing it.

Anything that stiffens a column against bending sideways strengthens it, anything that causes it to be more easily bent sideways weakens it. Thus a column with spreading flat ends is stronger than a column with rounded or jointed ends, and a column with a marked ENTASIS is stronger than one without it.

When a beam supported at both ends bends by flexure under a central weight, the concave curve is crushed together and the convex curve is under tension—midway is the *line of no disturbance.* Flexure is reckoned upon this line, and is found to vary directly as the load, or as the cube of the distance between the supports, and inversely as the product of their breadths with the cube of their depths. If the load, instead of being accumulated at the centre, is spread all along the beam the pressure is reduced to the proportion of five to eight.

FLEX'URE, CONTRARY. A point of contrary flexure in a curve is that at which the branch of the curve ceases to present convexity to a straight line without it, and begins to present concavity, or *vice versâ.* But when a straight line passes *through* a point of contrary flexure, the curve presents either convexity on both sides or concavity on both sides.

FLIGHT, or **FLYING,** is the locomotion of an animal in the air by means of wings, which are made to beat or strike it. It is analogous to swimming, but requires greater muscular power, as water is about 800 times heavier than air. Birds and bats are the only existing vertebrate animals possessing the power of true flight. Other vertebrates can float in the air for brief intervals by means of membranous lateral expansions, as in the flying squirrels, flying lemurs, and dragons, or by the great development of the pectoral fins, as in the flying fishes, or by very long webbed toes, as in certain tree-frogs. None of these animals can be said to fly, the wing-like expansion merely sustaining the body for a short space of time, and having no part in its propulsion. Certain reptiles, the pterodactyles, extinct since the Secondary period, possessed the power of true flight. The only invertebrate animals possessing the power of flight are insects.

Birds, bats, pterodactyles, and insects can alone be said to fly. In the case of bats the fingers of the fore-limb are much elongated, and between them stretches a membrane which extends to the sides of the body and the legs. The organ of flight of the pterodactyle was formed by the enormous elongation of the fifth finger of the fore-limb for the support of a similar membrane to that of the bat. In the bird the whole forearm is concerned in the construction of an organ of flight. The wings of insects are not at all homologous, being merely expansions of the integument, but they are strictly analogous, acting on a common principle with those of birds and bats. Lightness is not, as might be imagined, of first importance for a flying animal. What is needed is weight to control the winds and currents of the air, and great muscular strength to move the organs of flight with sufficient rapidity. The rate at which the wings move is enormous, the common house-fly, for instance, making 330 beats per second. The necessity for this excessive rapidity lies in the fact that the air, being a very thin, light, elastic medium, presents very little resistance to bodies passing through it; unless therefore the speed at which such bodies move is very great the recoil is not sufficient to secure the onward impetus. All wings present oblique kite-like surfaces to the air, striking it as an oar strikes the water in rowing. Professor Pettigrew, who has thoroughly investigated the question of flight, has shown that wings are structurally screws, and act as screws when made to vibrate, from the fact that they twist in opposite directions during the down and up strokes. The down strokes of flying animals are directed downwards and forwards, so that the wings when in motion are in advance of the body and pull it along. Professor Pettigrew points out that the wings of flying animals, when their bodies are fixed, describe figure-of-eight tracks in space, which tracks, when the bodies are released and advancing, as in rapid flight, are opened out and converted into waved tracks.

Projects of locomotion through the air by means of artificial wings, &c., have been much entertained from the thirteenth to the present century, but with little practical success. See BALLOONS.

FLIN'DERS, MATTHEW, was born at Donington, in Lincolnshire, in 1774. He went early to sea, and became a most adventurous navigator and discoverer, chiefly in and near Australia. On his return from his last voyage he was taken prisoner by the French, and was detained for six years; but he was enabled after his liberation to complete an account of his discoveries, "A Voyage to Terra Australis," which gave to the world a fuller account of the great island-continent than had ever been given before. He died in July, 1814, on the very day on which his book was published. Flinders Land (now South Australia) and Flinders Islands (a group of islands off the north-east coast of Australia, near the entrance to Bathurst Bay) were named after this navigator.

FLINT, a county in the northern part of Wales, is bounded N.W. by the Irish Sea, N.E. by the estuary of the Dee, S.W. by Denbighshire, and S.E. and E. by Denbighshire and Cheshire. The greatest length, S.E. to N.W., is about 25 miles; the width, S.W. to N.E., is generally about 10 miles. There are also two outlying portions. The entire area is 264 square miles, or 169,162 acres, it being thus the smallest Welsh county. The population in 1881 was 80,587.

The coast is generally low, and is skirted by sands. There are no hills of great elevation. A range extends south-east to north-west, from the slopes of which many small streams flow, on one side into the Dee and on the other into the Alyn. Another range enters the county on the north-west, from which flow some of the affluents of the Clwyd. The Clwyd rises on the eastern declivity of the Bronbanog Hills in Denbighshire, and flows first south and then east-north-east. A little above Ruthyn it turns north, and flows through the fine vale of Clwyd, partly in Denbighshire and partly in Flint. Its whole course is about 30 miles.

The New Red Sandstone occupies much of Flint. The coal measures occupy the coast of the estuary of the Dee,

and the coal-field, which has several seams of various thickness, extends across the county. About forty mines are worked, producing annually over 550,000 tons. Beds of shale and sandstone underlie the coal measures, and crop out from beneath them, separating the coal-field from the district occupied by the mountain limestone. This last-named rock occupies all the remainder of the county except a small tract occupied by the Old Red Sandstone: extensive and valuable lead-mines are worked in the limestone, especially near to Holywell, the county supplying a fourth of the lead raised in Great Britain. Copper, iron, zinc, and calamine are also found.

The occupations of the inhabitants are divided between agriculture, mining, and manufactures, the first-named employing the largest number and being most widely diffused. The soil is fertile in the plains and vales, and the quantity of land devoted to corn is greater in proportion than that of any other Welsh county. The cattle and sheep are the native breeds crossed with Herefords and Southdowns, and the cows are celebrated for the quantity and quality of their milk.

The manufactures of the county are almost entirely in connection with metals, but there are also a few woollen and cotton mills.

Divisions and Towns.—Flint is divided into five hundreds. It constitutes parts of the dioceses of St. Asaph and Chester, in the province of Canterbury. It is included in the North Wales and Chester circuit, and the assizes are held at Mold, the county town. The line of railway connecting London with Holyhead traverses Flint. One member is returned to Parliament for the county, and another for Flint and its contributory boroughs. The number of electors on the county register is 4,900.

Flint has been the scene of some interesting historical events, and possesses many antiquities. There are remains of lead-mines worked by the Romans, and it is traversed by Wat and Offa's dykes. A short distance from Mold the Britons gained their "Alleluia" victory over the Picts and Scots in 840. A victory of the Saxons over the Welsh in this county in 796 gave rise to the well-known air of "Morfa Rhyddlan." About a mile from Flint Henry II. was defeated by Owain Gwynedd. There are numerous tumuli and inscribed stones, and the ancient castle at Caergwyle may be of Roman or even earlier origin.

FLINT, from which the above county derives its name, is situated on the estuary of the Dee, 12 miles north-west from Chester, and 191 from London by the North-western Railway. It was formerly the county town, but this distinction has been transferred to Mold. It was probably a Roman station, as Roman antiquities have been dug up in the neighbourhood, and traces have been found of Roman establishments for smelting lead ore. The castle, of which some ruins still exist, was probably built by Edward I. The town contains a church, a guild-hall, a national school-house, an almshouse for twelve poor burgesses, a parochial chapel, and two or three dissenting places of worship. The obstructions caused by the shifting sands in the channel of the Dee above Flint have caused it to become in some degree the port of Chester, to which place the goods are forwarded in lighters, &c., and the approach to the quay has been so much improved that large vessels can come up to it at any time of the tide. The neighbouring lead and coal mines, and the works for smelting lead, give employment to a great number of persons, and the establishment of extensive chemical works has greatly tended to restore its former commercial prosperity. Flint is a municipal borough, governed by a mayor, four aldermen, and thirteen councillors. Population, 4,744. The town unites with St. Asaph, Caergwyle, Caerwys, Holywell, Mold, Overton, and Rhyddlan, in sending a member to the House of Commons.

FLINT is a variety of hornstone, a subspecies of chalcedonic or amorphous quartz. It appears to be an intimate mixture of two kinds of silica, one of which is soluble, the other insoluble, in caustic alkalies. There is generally from 1 to 2 per cent. of water, and about 1 per cent. of alumina and ferrous oxide; the colour (which varies from gray to black) is generally due to organic matter. Its hardness is about 7, specific gravity about 2·6, cleavage sharply conchoidal, sometimes conical. Flints are generally formed by deposition of silica from sea water round a nucleus of silica secreted by organic agency (*e.g.* a sponge), or occasionally round a calcareous nucleus (*e.g.* an echinus or a shell) partly or wholly impregnated with silica. The upper chalk of England and north-western Europe contains enormous quantities of flint; masses of closely analogous nature occur in the Carboniferous and Devonian limestones. *Chert* is closely allied to flint, from which it differs in being less lustrous and compact, and in the fact that it does not show a conchoidal fracture.

FLINT IMPLEMENTS. See STONE IMPLEMENTS.

FLOATING BATTERIES were formerly used in defending harbours or attacking sea-side fortresses, and consisted of large hulks, heavily armed, and made as invulnerable as possible. Ten of these vessels, carrying 212 large guns, were used by the French and Spaniards in their siege of Gibraltar, 1779–83. The sides of the batteries were fortified by 7 feet of timber and other materials, supposed to be obstructive of shot; they were covered by slanting shot-proof roofs, and were intended to be moored by massive chains within half range of the rock. The defenders, under General Eliot, concentrated on the batteries unceasing volleys of red-hot shot, and all of them were destroyed by fire. The English and French governments sent steam floating batteries cased in iron, to be used in the war with Russia in 1854; but they were found to be of questionable value, and they were soon afterwards suspended by the introduction of iron-clad vessels of war.

FLOATING BRIDGE. See BRIDGE.

FLOATING DOCK. See DOCK.

FLOAT-STONE is the name given to loose-textured concretionary masses of opal-silica, which from their cavernous structure are light enough to float on water. Nodules of it have been found near Paris.

FLOD'DEN, a village of England, in the county of Northumberland, 5 miles south-east of Coldstream, memorable as the scene of one of the most destructive conflicts recorded in British history. James IV., king of Scotland, having invaded England with a large force, was encountered here on the 9th of September, 1513, by an English army under the Earl of Surrey. James, who was destitute of every quality of a general except bravery, was killed, and his army totally defeated. The loss on the part of the Scotch was extremely great. Besides the king, no fewer than twelve earls, thirteen lords, and five eldest sons of peers, with a vast number of gentlemen and persons of distinction, and probably about 10,000 common soldiers, were left on the field. The loss on the part of the English was comparatively inconsiderable. This is by far the most calamitous defeat in the Scottish annals, and as there was hardly a family of distinction in the kingdom who did not lose one or more members in it the whole nation was involved in mourning and despair.

FLOGGING, a punishment generally administered with a whip or "cat-of-nine-tails" on the bare back of the offender. For many years the practice of flogging criminals was abolished in England, but by the 26 & 27 Vict. c. 44, it was reintroduced in cases of robbery with violence. It was formerly inflicted in the army and navy for comparatively slight faults, and was supported by many humane and experienced practical men as the wisest and sometimes the kindest method of punishing breaches of discipline among soldiers and sailors, under the peculiar conditions of their services, but it was also condemned by a large number of humanitarians as having a brutalizing

effect. The latter have carried the day, and flogging in both services was abolished in 1882.

FLOOR'CLOTH, a kind of strong canvas made sometimes of jute and sometimes of hemp or flax, and having the surface covered with oil-paint and decorated with designs, which were originally applied with the brush, then by a process of stencilling, and lastly by printing from blocks. As a means of avoiding the necessity for seams or joinings in the cloth, looms are constructed expressly for the weaving of canvas of the greatest width likely to be required. The canvas is produced almost entirely in Scotland, chiefly at Dundee, and the degree of fineness is generally such as to present sixteen or eighteen threads to the linear inch.

The canvas is cut into pieces varying from 60 to 100 feet long. Each of these pieces is stretched over a frame in a vertical position; and in most of the factories there is a large number of such frames, some 100 feet long by 18 or 20 high, others 60 feet long by 24 high. A wash of melted size is applied by means of a brush to each surface; and while this is yet wet the surface is well rubbed with a flat piece of pumice-stone, whereby the little irregularities of the canvas are worn down and a foundation is laid for the oil-colour afterwards to be applied. The paint employed consists of the same mineral colours as those used in house painting, and like them is mixed with linseed-oil; but it is much thicker or stiffer in consistence, and has very little turpentine added to it. The canvas receives several coatings on the back as well as the front, applied not with a brush but with a sort of trowel, and is well dried by means of a current of warm and moist air, and smoothed at intervals.

The printing of floorcloth is conducted much on the same principle as that of paper-hangings for rooms, and that of colour-printing—viz. the successive application of two or more blocks or engraved surfaces, each one giving a different part of the device from the others, and being supplied with paint of a different colour.

The paint (say red) is applied with a brush to the surface of a pad or cushion formed of flannel covered with floorcloth; the block, held by a handle at the back, is placed face downwards on this cushion, and the layer of paint thus obtained is transferred to the surface of the canvas by pressing the block smartly down on the latter. A second impression is made in a similar way by the side of and close to the first; and so on throughout the length and breadth of the canvas, each impression being about 15 inches square. The proper junction, or register, of the successive impressions is aided by an arrangement of metal bars extending across the table on which the printing is done, and the requisite pressure is given to the block by movable mechanism adapted to bring an equal pressure to bear on every part of the block's surface. The blocks used are generally of wood, though they are sometimes cast in type-metal. When the whole surface is thus printed with one colour, all the others are similarly applied in succession. The greater the number the greater is the care necessary in adjusting the numerous partial impressions so as to insure a proper arrangement of the whole.

Kamptulicon floorcloth is composed of india-rubber or gutta-percha, and ground cork. These are intimately mixed and kneaded between rollers and pressed into the form of a sheet. Patterns are printed upon it in precisely the same way as ordinary floorcloth. The peculiar characteristics of kamptulicon are its softness, warmth, and elasticity; but its relatively high price always limited its use, and since the introduction of the cheaper linoleum the demand for it has been even smaller.

Linoleum is a kind of floorcloth made from dried linseed-oil and ground cork pressed between rollers. The oil is exposed to the air, and its oxidation assisted by heat until a solid resinous substance is formed, which serves instead of the india-rubber used in the last process. A proportion of resin is sometimes added to it, and the whole intimately mixed with an equal weight of ground cork or sometimes finely-ground sawdust. When rolled into a sheet its surface is often decorated with printed patterns in oil-colour in the same way as floorcloth, but as this coating makes the surface harder and colder it is usual to confine such decoration mainly to the border. The use of this floor covering has rapidly extended of late years.

Boulinikon is another form of floorcloth patented in 1865. It is composed of waste hides, pulped cotton or linen rags, and ground-up coarse hair.

FLO'RA, in the Roman mythology, was the ancient goddess of spring and of flowers, and the wife of Zephyr. As early as Numa there was a flamen or state priest appointed to the temple of Flora. In her honour were celebrated, by virtue of a command in the mysterious Sibylline books, games or festivals called Floralia, at the end of April, in which women of loose character performed dances and mimic fights, throwing beans and chick-peas among the crowd. Confusing these floralia with some festivals instituted by a courtesan named Chloris, certain later Latin writers even attributed to the goddess herself a like disreputable origin. This is of course perfectly absurd. Flora was one of the most ancient of the Roman deities. Floral games, "Jeux Floraux," was the name given to the poetical assemblies and competition for prizes held at Toulouse. See CLEMENCE-ISAURE.

FLO'RA, in botany. The collective vegetation of a country is called its *flora*, and in like manner its animals are called its *fauna*. A work containing an account of the various plants growing in a country, or a certain part of a country, is called the flora of that district.

FLOR'ENCE or **FIREN'ZE,** the capital of Tuscany, and an archiepiscopal see (for a time the capital of the kingdom of Italy), is situated in the valley of the Arno, which river divides it into two unequal parts, connected by four bridges. Its shape is a pentagon, and it is about 6 miles in circuit; it was formerly inclosed by walls, which were removed after its occupation as the capital of Italy. In the central or most ancient part of Florence the streets are mostly narrow and irregular, and many of the houses have a mean or dilapidated appearance, though here and there are fine churches and massive square stone palaces. But the streets which lead from this central part, and which from their more recent date are still called Borghi or suburbs, are laid out on a regular plan. The most remarkable structures in Florence are—1. The Duomo. or cathedral, which was begun at the end of the thirteenth century by Arnolfo di Lapo, was continued by Giotto and other successive architects, until Brunelleschi completed it in the fifteenth century by raising the noble cupola which excited the admiration of Michael Angelo. This magnificent building is surrounded by an open place; on one side is a square tower, 250 feet high—known as the Lily of Florence, and considered by Ruskin to be the most perfect production of architecture (see Plate CAMPANILE)—and before it the Baptistery of St. John, an octagonal chapel rich with sculptures and mosaics. The whole group of buildings is cased in marble party-coloured black and white. 2. The Palazzo Vecchio, or town-hall, a square massive-looking structure surmounted by a tower 260 feet high. The square in front is adorned with a noble fountain and with marble and bronze statues. 3. Gli Uffizi, with arcades forming three sides of an oblong court 400 feet in length; the first storey is occupied by the archives and the Magliabecchi library, which contains 150,000 printed volumes and 12,000 MSS. The second storey contains the celebrated Galleria, or museum, formed by the Medici, which is one of the richest existing collections of sculptures, medals, cameos, bronzes, paintings, and other works of art. 4. The Church of San Lorenzo, built by Brunelleschi, the numerous altars of which are adorned with the paintings of Florentine

masters. 5. The Church of Santa Croce, remarkable for the monuments of Michael Angelo, Machiavelli, Galileo, Alfieri, and Dante. 6. The Palazzo Pitti, once the residence of the grand-duke, and which was afterwards used as that of the King of Italy, has a splendid gallery of paintings and a library of 70,000 printed volumes and 1500 MSS. Besides the above are—the Palazzo Riccardi, with its valuable library; the Palazzo Strozzi, one of the most remarkable specimens of the old massive and stern Florentine architecture; the modern palaces of the Corsini, Borghese, and many others; the churches of San Marco, Santa Maria Novella, L'Annunziata, Ognissanti, &c.; the two principal theatres; the academy of the fine arts; the hospitals; and the public walks outside the gates. The educational, scientific, and charitable institutions are numerous.

Florence is upon the whole the most pleasant place of residence in all Italy. The climate is not unhealthy, though the cold is great in winter and the heat is sometimes oppressive in summer. The best months are April, May, and the first half of June, and September, October, and November. Strangers have also the advantage of the best reading-rooms in the whole peninsula, which are supplied with foreign journals and literary novelties. The neighbourhood of Florence is studded with villas, country-houses, and gardens, and outside the old line of the walls is one of the most magnificent promenades in Europe. The population in 1881 was 169,001.

This town owes its origin to a colony of Roman soldiers, sent by Cæsar Octavianus after the victory of Perusia, to whom he allotted part of the territory of the colony of Fæsulæ, established about forty years before by Sulla. The Longobards occupied Florence apparently without violence, and Tuscany became one of the duchies of their kingdom. Charlemagne, having conquered the Longobards, organized the various provinces of their kingdom, and gave to Florence a sort of municipal government. From about the year 1115 the towns of Tuscany began to govern themselves as independent commonwealths, and the popes favoured this state of things. Florence had then a very limited territory, extending only a few miles round its walls; but the industry and speculative spirit of its citizens wonderfully enriched it.

The most remarkable feature in the history of Florence has been the internal dissensions among her most powerful citizens. When the struggle for temporal power took place between the popes and the emperors, Florence was for the most part favourable to the former; but as some of the most influential inhabitants favoured the emperors, the seeds of discord were sown which led to many fierce contests afterwards. Such was the feud between the Uberti family and the municipal council in 1177; the feud between the Uberti and the Buondelmonti, &c. These gave rise to actual wars in the thirteenth century.

After the feuds of the Bianchi and the Neri, and the banishment of the former, the Florentines besieged and took Pistoja by famine in the year 1306, and during the same century they were frequently at war with other Italian cities. Yet these wars, with their chequered results, did not drain the sources of the extraordinary wealth and power of the Florentines. These sources were twofold—the numerous manufactures at home, and the trade and banking speculations carried on by Florentine merchants abroad. Among the manufactures the most important were those of woollens, silks, and jewelry. The eminence to which they had attained in the financial world was shown by the rapid acceptance of their golden florin, coined about 1552, as a standard of value. The citizens of Florence were classed from 1266 into twelve arti or companies of trades or professions. Every citizen who wished to be eligible to office was required to inscribe his name on the rolls of one of the trades. Their armies were chiefly composed of mercenaries and auxiliaries, and mostly commanded by a foreign captain or condottiere. The towns and districts subject to Florence retained their local statutes and elected their own magistrates, but they had no share in the central government of the republic.

The Florentines occasionally placed themselves under the protection of some neighbouring potentates; but these protectors generally soon became unpopular, and were expelled by the citizens. Frequently, too, the trades gave battle to the nobles within the streets of Florence itself. The wealthy family of the Albizzi remained at the head of the republic during the greater part of the time from 1343 to 1434, in which last-mentioned year the administration of the Albizzi was overthrown by Cosmo de' Medici, a popular citizen and a princely merchant. From that moment the history of Florence became closely connected with that of his house. See MEDICI.

In 1864 Florence was chosen to be the capital of the new kingdom of Italy, and the seat of government was removed thither from Turin in January, 1865. The political, military, and historical grounds on which the transfer was justified were acknowledged by the general sense of the nation. After that event whole streets of buildings were erected in every direction, and new houses of first-class character built, especially in fashionable quarters. It was, however, understood that the honour of being the chief city of the kingdom was to be only temporary, although at that time there seemed little probability that the capital would be transferred to Rome so soon as 1870. After that event Florence subsided to some extent to her former position, but the municipality so far carried out the demolitions and improvements initiated from 1864 to 1870, that the result has been a permanent gain to the city in points of health, comfort, and magnificence.

Florence has produced more celebrated men than any other town of Italy, or perhaps of the world; among others may be specified Dante (a fine statue of whom was erected in 1865), Petrarch, Boccaccio, Villani, Cosmo and Lorenzo de' Medici, Galileo, Michael Angelo, Leonardo da Vinci, Benvenuto Cellini, Alberti, Lapo, Brunelleschi, Giotto, Andrea del Sarto, Macchiavelli, Popes Leo X. and XI. and Clement VII., VIII., and XII.

FLOR'ENCE, COUNCIL OF. This was one of the most important of œcumenical councils in the work it attempted, but in reality it accomplished nothing whatever. It was in fact not truly œcumenical, since it represented only papal Christendom. It was first called at Ferrara in 1438, and had for its especial aim nothing less than the reconciliation of the Greek Church with the Latin. The Emperor John Palæologus was at the mercy of the Turk, and it was simply a bargain between him and Pope Eugenius IV., that if he forced the Greek clergy to agree to unite the two churches he should receive the support of Europe in a final crusade. So close was the Sultan Amurath to his gates that as the emperor sailed from Constantinople the barbarians amused themselves with exciting terror among the imperial ships by showers of javelins, which they threw from the shore. The emperor himself had a narrow escape.

The pope had another reason for consenting to the Greek bargain. The Greeks declined (or Eugenius said they declined: the papal word cannot here be taken as authentic) to cross the Alps to Basel, where a powerful church council had been sitting for many years. [See BASEL, COUNCIL OF.] The council and the pope were on terms of mutual exasperation. The alleged conditions of the Greeks were laid hold of by Eugenius to insist that the council should remove into Italy; the fathers of Basel, well knowing that that would be the death-blow of their cherished independence, refused to quit Basel, unless it were for Avignon. Both pope and council sent a fleet for the Greeks, that of the pope (furnished by Venice) arriving first. The Greeks, in the direst poverty,

had neither vessels nor means to provide them. Condolmieri, the pope's nephew, in command of the fleet, showed his papal commission, when the fleet of the council hove in sight, while yet the emperor had not finished persuading the clergy to embark, and displayed the command to "burn, sink, and destroy the fleet" of the pope's enemies. In fact, he put off for that purpose, and was with the greatest difficulty restrained from battle by John Palæologus, to the amusement of the Turks who lined the shores a little way off, would-be spectators of the suicidal conflict between "these Christians who loved one another." Undeterred by this edifying proof of the unity of that church which he was invited to enter, the Greek emperor set sail, accompanied by the patriarch and chief clergy. To furnish himself royally forth John had to plunder the treasures of Santa Sophia itself amidst cries of sacrilege. Condolmieri had brought 15,000 florins, John appropriated 9000 of these also. The Greek clergy rebelled at this, and only after the greatest trouble were induced to do the best they could upon the remaining 6000. An earthquake signalized the departure of the ill-omened fleet.

Nevertheless the arrival at Venice was a compensation. The republic outshone itself in hospitality, and the counsel of the doge might yet have saved the Greeks their destined humiliation. He advised the emperor to stay in Venice and there balance the offers of the Council of Basel and of the pope. His good advice was not taken, and on 4th March, 1438, the emperor met the pope at Ferrara. Eugenius resorted to all kinds of tricks to extort something which might appear a sign of submission in the Greek ecclesiastics. The whole proceedings would be revolting if they were not so contemptible. The pope's throne was found to be elevated for the opening of the council, so that the Greek emperor and patriarch might publicly sit at his feet; the patriarch was always received by bishops instead of by cardinals, &c. The Greeks exposed each attempt as it was made, and defended themselves as well as they could. The pope let matters drag on, affecting to expect the submission of the Council of Basel; the Emperor John was not so badly off, hunting in the forests of the vicinity, but the Greek ecclesiastics were frequently in absolute hunger, and were confined to the city as if they were prisoners. Three escaped to Venice and were haled back ignominiously. Others, or the same perhaps, fled to Constantinople. In the autumn the plague broke out, and the council suffered much, so that next year it removed to Florence.

At Florence the points of dispute were thoroughly argued out, and therefore the council takes its name from that city. They were four:—(1) The ancient creed, still used by the Greeks, declared the Holy Ghost to proceed from the Father, the Latins added from the Father *and the Son*. It is perfectly clear that the addition was subsequent to the Council of Nicæa. (2) The Greek use of *leavened* bread in the eucharist. (3) Purgatory. (4) The supremacy of the pope. On the first question the two parties agreed to use the formula from the Father "through the Son," as expressing the procession of the Holy Ghost; and after long and stubborn disputes the Greeks agreed that this formula should be added to the creed. (It is perhaps needless to say that the Latins never varied from their ancient *filioque*, whatever they professed to agree to.) As the price of the strong pressure by which the emperor had forced the Greek clergy to agree to this disturbance of the Nicene Creed, the pope bound himself by treaty to supply ample means for the defence of Constantinople. (It is likewise needless to add that this treaty was never carried out.) The patriarch, worn out by humiliations, died; and the stranger wonders to-day at finding the tomb of a Greek primate in the Baptistery at Florence. His death removed many difficulties. The addition to the creed was admitted, the use of leavened or unleavened bread left optional, a certain belief in the fire of purgatory was vaguely formulated, as well as the doctrine that in some manner suffering souls were helped by the prayers of the faithful, and finally the supremacy of the pope was acknowledged with certain safeguards.

A grand service was held in the Latin form in the Duomo when the Act was published on 6th July, 1439. (About the same time, 25th June, the Council of Basel deposed Eugenius from the papacy by decree.) Next day the Greeks were about to celebrate the service in their own form, when they were coldly stopped by the pope, who refused to permit their public rites till they had been rehearsed in private before a commission to determine upon their legality. This was the last cruel blow.

On the return of the crestfallen dupes to Constantinople in 1440, they were received with execrations. The new patriarch stood alone at service in Santa Sophia, the Despot (or Dauphin) raising the standard of rebellion against his renegade brother. No priest dared recite the creed with the addition. The union made in trickery and bad faith dissolved at once, leaving behind it a more bitter hatred between the churches of the East and the West than before; while the result on Christendom at large was that in fifteen years from this time Constantinople was a Mohammedan city, and from 1453 till now that cathedral of Santa Sophia which refused to be polluted by adding the words "and from the Son" to the creed has resounded with the Imaum's chant, "There is but one God, and Mohammed is his prophet."

After the departure of the Greeks the exultation of Eugenius knew no bounds. The success of this "reconciliation" urged him on to fresh efforts; and Christendom was edified or amused, according to the temper of men's minds, by a procession of Armenians, Maronites, Jacobites, Nestorians, and Ethiopians, representing schismatic faiths, many of which no one had heard of, and coming no one knew how or whence, but all reverently kissing the feet of the Roman pontiff, and agreeing in acts of union with the council. Basel alone, it was lamented with increasing clamour, disturbed the orthodox union of the whole world. The closest research has as yet failed to verify any one of these extraordinary embassies to Eugenius. Perhaps it is not wonderful that on his deathbed he exclaimed, "Gabriel, better had it been for your soul if you had never left your monastery."

The rest of the work of the Council of Florence is quite unimportant. It was removed to Rome finally, and dissolved at the same time with its rival of Basel, in 1439 (The formal dissolution of the latter was in 1449, but its last sitting was in 1439.)

FLORENCE OF WORCESTER, one of the valuable native English chroniclers, was a monk of Worcester. He died in 1118. His Chronicle was based upon that of Marianus Scotus, up to 1082, where Scotus ceases, with additions from the English Chronicle (apparently a better copy than we now possess), Bede's "Ecclesiastical History," Osbern's "Lives of the Saints," and Asser's "Life of Alfred." After 1082 there is much more original matter, and the Chronicle becomes very valuable as a contemporary record. Florence continued it down to 1117, till near his own death; and other monks of Worcester carried it on to 1141. For a general account of these priceless histories see CHRONICLE.

FLO'RIAN, J. P. DE (1755–1794), was a pupil of Voltaire. He is a graceful writer of French verse, best known for a charming series of fables, second only to those of the incomparable LA FONTAINE.

FLOR'IDA, one of the states of North America, was first discovered by Sebastian Cabot in 1497, but the name was given to it by Juan Ponce de Leon, from his having discovered it on Palm Sunday (called in Spanish Pasqua Florida), in 1512. During a great part of the sixteenth

century the southern part of the eastern coast of North America continued to bear this name, which was gradually restricted to that portion of this coast now called Florida. This state comprehends a peninsula, lying between 25° and 30° 45′ N. lat., and 80° and 83° W. lon., besides a tract of land extending along the northern shores of the Gulf of Mexico, between 29° 40′ and 31° N. lat., and 83° and 87° 20′ W. lon. Its greatest length is 620 miles; the width varies from 30 to 250 miles. The area is 59,268 square miles. The population in 1880 was 269,493.

Opposite the southern extremity of the peninsula there is a series of keys (a corruption of *cayos*) or islands, mostly covered with wood. These islands, which are called the Florida Keys, are skirted towards the south and east by narrow reefs, called the Florida Reefs. The whole of the eastern coast of the peninsula is flat and skirted by low narrow islands of sand, separated from the mainland by narrow and shallow lagoons, which cannot be navigated even by vessels of small burden. This coast has no harbours, except at the northern extremity, where that of St. Augustine has 10 feet water at high tides, that of St. John 15 feet, and St. Mary's 20 feet. There are many bays on the western side of the peninsula, which form good harbours. Tampa Bay is spacious, and admits vessels of considerable burden; but the best harbour is Pensacola, in the western part of Florida, which admits vessels drawing 20 feet of water, and is the deepest port on the northern coast of the Gulf of Mexico.

The surface of the country is uneven, but it contains no high hills. The peninsula is drained by several small rivers, and by the St. John River, of which the main branch, the Ocklawaha, rises midway between both seas, and runs north for about 80 miles, when it turns east and joins the other branch or St. John proper. After their union the channel of the river is very wide, and the current is slow for the remainder of its course, which rather exceeds 80 miles, and is directed to the north till it turns eastward and falls into the Atlantic. It is 15 feet deep, and may be navigated some distance above the place where the two branches unite. The Appalachicola, the chief river of the western part of Florida, is naviagble for about 80 miles from the Gulf of Mexico by vessels drawing 8 feet of water. The St. Mary's River forms a part of the boundary line between Florida and Georgia, and the Perdido divides Florida from Alabama.

Florida has a considerable number of lakes, the largest being in the swampy districts of the peninsula. The Lake of Macaco is the most extensive. Lake George, an expansion of the St. John River, is 18 miles long and 12 wide.

The climate of Florida is favourable to the cultivation of most of the productions of the West Indies, where the soil is suitable. The sugar-cane may be cultivated in all the maritime parts, and the orange flourishes. Cotton is the chief agricultural production, but rice, indigo, tobacco, Indian corn, and a great variety of fruits, are also cultivated. Pine trees cover a great part of the northern districts, but the forests contain also cedars, chestnuts, magnolias, cypresses, and other trees.

Wild quadrupeds of the larger description are not numerous, except deer. Alligators, turtles, and snakes are very common.

In 1763 Florida was ceded to Great Britain by Spain in exchange for Havana. It was reconquered by the Spaniards in 1781, and was confirmed to them by the peace of 1783. In 1821 it was ceded by the Spaniards to the United States. The state seceded from the United States in 1861, but was not the scene of any important events during the civil war.

FLORID'EÆ, a group of Algæ which are almost all red-coloured sea-weeds. One of the exceptions is a beautiful object for the microscope, Batracho-spermum; the cells composing its long threads are arranged like the beads on a necklace; it is of blackish colour, and grows in fresh-water streams, attached to stones. As a rule the Florideæ are inhabitants of the sea, and the green colour of the chlorophyll is concealed by a red pigment, so that they are of a reddish or violet colour. A more fundamental distinction is that the fertilizing bodies (spermatozoids) are endowed with motion, combined with the elaborate apparatus for fertilization. The fruit arises from the development of cells at the ends of branches. In a typical example (Lejolisia) the apical cell is divided by a partition into a terminal cell, which no longer grows, and a broader cell, which splits up by longitudinal walls into five cells, one in the axis and the rest round it. One of these latter becomes coloured, and divides into three cells; this is the trichophore. The uppermost of these cells lengthens into a slender hair, the trichogyne; this is fertilized by the spermatozoids, and as a consequence the three other cells round the one in the axis grow into branches, which grow up close to one another, forming a peculiar "pericarp." The spores arise in the centre of this pericarp as outgrowths of the central cell.

FLOR'IN, a silver coin of different values in different countries. The Dutch florin, of 100 cents., is equal to 1*s.* 8*d.* The Austrian florin or gulden, of 100 kreuzers, is equal to 2*s.* The English florin is equal nominally to one-tenth of a pound, or 2*s.* From the introduction of the florin, in 1852, to 1874 no half-crowns were coined; and as the latter coin was then becoming scarce, a circular was issued by the Mint authorities to the leading bankers asking if they would prefer (1) the non-issue of half-crowns continued; (2) that no more florins, but only half-crowns, should be issued; or (3) that both half-crowns and florins should be issued. A large majority having asked that both coins should be issued, the coinage of half-crowns was at once recommenced. The florin was at first a gold coin, originally issued at Florence, whence the name is said to be derived. though some think that the word comes from the Latin *flos*, a flower, from the circumstance that it had on the reverse side the impress of a lily. Both derivations come to much the same thing, since Florence herself derives her name from *flos;* and when she became Christian adopted therefore as her emblem the flower of flowers, the lily of the Virgin Mary.

FLOS FERRI, a curiously branching stalactitic form of aragonite, first found in the iron mines at Eisenerz, in Styria. The German miners, imagining that it grew from the iron ore, called it "flos ferri," or flower of iron. It is found also at Guanaxuato, in Mexico, and Arkingarthdale, in Yorkshire. Very fine specimens have recently been obtained from the last-mentioned locality.

FLOT'OW, FRIEDRICH, BARON VON, an operatic composer of considerable merit, was born in the grand-duchy of Mecklenburg in 1812, and made his first public successes at Paris; his opera "Marta" being perhaps the only one of his works that will eventually survive. This was originally produced at Vienna in 1847, and has since been very popular at both our great Italian opera establishments, and generally throughout Europe. Although it is not a work of high musical accomplishment, it is yet full of genial melody (including the skilful use made of the Irish tune "The Last Rose of Summer"). "Marta" has always been warmly welcomed, and its popularity still remains undimmed. It is undoubtedly assisted by an excellent story, with telling humorous situations. This composer's operas of "Stradella," "Alma," and "L'Ombre" have not succeeded so well, except so far as the overture to the first is concerned. This is a very favourite and striking orchestral work. Flotow died at Wiesbaden on 24th January, 1883.

FLOT'SAM or **FLOATSAM** is such portion of the wreck of a ship and the cargo as continues floating on the surface of the water. *Jetsam* is goods which are cast into

the sea, and there sink and remain under water. *Ligan* is goods sunk in the sea, but tied to a cork or buoy, in order that they may be found again.

Flotsam, jetsam, and ligan belong to the crown or its grantee if no owner appears to claim them. They are accounted so far distinct from legal wreck that by the crown's grant of wreck flotsam, jetsam, and ligan will not pass. Wreck was frequently granted by the crown to lords of manors as a royal franchise; but if the queen's goods are wrecked she can claim them at any time, even after a year and a day. The same distinction, it is presumed, would prevail with respect to flotsam, jetsam, and ligan.

The Merchant Shipping Act of 1876 contains clauses providing for the investigation of casualties; it also appoints receivers of wrecks, and enacts certain rules which are to be observed for preserving or realizing property, and the restitution of it to the lawful owners.

FLOUN'DER (*Pleuronectes flesus*), one of the FLAT-FISH family (Pleuronectidæ), is very common on the coasts of Britain and northern Europe as far as Iceland. It also lives in fresh water, entering rivers freely; in the upper Thames it has now become almost extinct, and those taken seldom exceed 2 or 3 inches in length. The flounder resembles the plaice in form, but has bands of rough tubercles on the side of the head, and also rows extending along the bases of the dorsal and anal fins. The colour varies, imitating that of the ground on which the animal lives. It rarely exceeds 12 inches in length. The flounder falls a prey to many sea-birds, as the divers, cormorants, &c.

FLOW OF LIQUIDS. Torricelli first taught the laws governing the flow of liquids from holes in the bottom or in the sides of vessels. Manifestly, by theory, a stream of liquid falling freely down a tube from a state of rest at the top should flow out at the bottom with the velocity of any falling body for the like distance, and this independent of the density of the liquid. Such an imaginary tube may be considered to exist in the form of a moving column above any hole in the bottom of a cistern, and although the particles of falling fluid do disturb and are retarded by the particles adjacent to these in the rest of the fluid beyond the imaginary moving column, yet the law is not so greatly interfered with as might be expected. Mobility rather than density affects the flow. Oil and glycerine flow more slowly than water, but the dense mercury, because of its mobility, flows at the same rate as water. The quantity discharged varies approximately as the square root of the depth and the size of the opening. Four times the depth, or twice the area of the hole, give, either of them, about a double flow.

The calculations holding good of a vessel completely full, and kept full, as regards flow from holes in its sides, these results follow:—If a given quantity is discharged from a hole 1 inch from the top, twice the quantity will flow from a hole at 4 inches down, thrice the quantity from one 9 inches down, &c. It is clear that water flowing from the side of a vessel by the pressure of the fluid within must obey the laws of projectiles; and its curve of falling is consequently a parabola, of which the axis is the side of the vessel, and the focus is a point as far below the orifice as the orifice is below the surface of the fluid.

Actual experiment shows that the flow of water from an unprotected hole in the bottom of a vessel is about 60 per cent. of the theoretical calculation; and the waste of 40 per cent. is believed to be caused by the loss of momentum in the current through adjacent particles at rest near the bottom of the vessel being dragged along with the current, and therefore retarding it by their inertia. Further, such particles entering from the side would get a rotatory motion, and would drive in towards the centre of the column, thus causing the contraction of the vein of water (*vena contracta*) always observable just below an orifice. Lower down the vein breaks into drops unable to withstand the tension of the rapidly increasing momentum due to gravity. The curious behaviour of the breaking vein was first investigated by Felix Savart; it is also beautifully described by Professor Tyndall ("Sound," London, 1883). Illuminating a vein of falling water by a flash of electric light, so that the shape of the separate drops is revealed for an instant, gives an apparently stationary picture, and clearly explains the phenomenon. To the naked eye the vein, at first (when solid) clear and pure, becomes turbid and unsteady, then it shrinks and swells in a remarkable manner. The cause is this: as the first drop breaks from the stream under the overpowering force of gravity which is dragging the stream faster than, on account of its limited cohesive power, it can fall, it is of course excessively lengthened (prolate). When it bursts away it tends to become spherical, and contracts so violently that it passes the spherical and assumes the oblate form, the stream appearing of course to be thickened. Thence rebounding it again passes through the spherical to the prolate form, and the stream is thin again. So the drop oscillates about sphericity, and the stream grows thick and thin. The flash of electric light reveals all these drops in continuous series through prolation to sphericity, and onwards to oblation, &c. Further, this delicate test reveals the presence of spherules of great minuteness, one between each full-sized drop, the whole pattern being one of great beauty. Upon sounding the appropriate musical note corresponding with the rate of drop vibration, the vein shivers into drops almost up to the orifice.

The flow is aided by a spout at the orifice, protecting the vein of water from the pressure of the air, and usually doing away with the loss by the *vena contracta*. As much as 80 per cent. of the theoretical flow will be thus obtained.

Since falling bodies acquire a certain velocity, it is to be assumed that if their motion be changed, without disturbing the velocity thus gained, to an upward motion, they will exhaust that velocity by rising nearly to the height whence they have fallen, due allowance being made for friction, &c. Consequently we expect that a stream of water falling from a vessel by means of an upward curving tube will rise from the extremity of that tube to the height of the surface whence it descended. It will in fact rise to nine-tenths of that height when the tube is so bent as to give it a sloping course; but a vertical course, as in the jet of a fountain, does not permit this, because the first drops to reach the extreme height, falling back upon their successors, prevent them from attaining their full extent of flow.

FLOWER is that part of the plant which bears the organs of reproduction, namely stamens (see Plate I. BOTANY, fig. 2, *st.*) and pistils (fig. 2, *o*), which cooperate in the production of seed. Some flowers have stamens only, when they are called male flowers, as in the willow (fig. 13, *a*); some pistils only, when they are called female flowers (fig. 13, *b*); and others have both stamens and pistils, when they are said to be hermaphrodite (figs, 2, 3, &c.) The stamens and pistils are the essential parts of flowers, but generally each separate flower is surrounded by the "leaves of the blossom," which very often occur in two whorls, the outer green, called the calyx, and the inner coloured, called the corolla. When the calyx is composed of separate leaves, each one is called a sepal (fig. 2, *s*), and in the same way each separate leaf of the corolla is called a petal (fig. 2, *c*). Those plants among DICOTYLEDONS which have corollas of separate petals, form a division, named POLYPETALÆ. To this division belong figs. 1–5 of Plate I. BOTANY. When the corolla is in one piece, though it may have lobes more or less deeply divided, it is said to be gamopetalous, and the division of Dicotyledons which contains such flowers is called GAMOPETALÆ (figs. 6–9). Dicotyle-

donous flowers without a corolla form the division APETALÆ; they may or may not have a calyx (figs. 10–13). Monocotyledons generally have the two whorls of the same colour, as in orchis and trillium (see Plate II. BOTANY, figs. 6, 8), and in these flowers they are collectively known as the perianth. That part of the floral axis which bears the calyx, corolla, stamens, and pistil is called the receptacle (see Plate I. BOTANY, fig. 2, *r*); in the rose it is cup-shaped, inclosing the ovaries. The fig is the receptacle of an inflorescence, concealing the minute flowers; the "seeds," so called, are in fact the ripe fruits. In a "composite" flower like the daisy the receptacle bears a great number of tiny flowers.

The flower occupies the place of a leaf-bud, and it is evident that all the separate parts, even the stamens and pistils, are metamorphosed leaves. The change from leaves to bracts, and again from bracts to sepals and petals, is often very gradual; a good example is seen in a cactus flower, Mammillaria. In the water-lily (Nymphæa) there is a gradation from sepal to stamen. A "symmetrical" flower is one in which the number of sepals, petals, stamens, and carpels is the same. A "regular" flower is one in which each member is similar to every other member of the same whorl. The question of cross-fertilization and the adaptation of flowers for this purpose are discussed in the article FERTILIZATION. The various parts of the flower, namely the calyx, corolla, stamens, and pistil, are more fully treated of under these headings.

Some flowers are employed in medicine. The camomile and feverfew are popular tonics and febrifuges. The dried flower-buds of several species of Artemisia are sold, under the name of wormseed, as anthelmintics. The flowers of the common mallow are used for the preparation of a drink, administered for headaches, feverish colds, &c.; this is known in France as *tisane*. Elder-flowers serve for fomentations, and are also made into a medicinal tea. The petals of the field-poppy yield a coloured syrup, possessing slightly narcotic properties. The female flowers of the hop are very small, occurring two together at the base of a broad scale. A number of these scales overlap one another, forming a cone. These cones constitute "hops." Perfumes are extracted from the rose, clove, orange flowers, jessamine, and lavender. The receptacles of the fig and artichoke are eaten. Capers are pickled flower-buds of *Capparis spinosa*. Saffron consists of the dried stigmas and part of the styles of *Crocus sativa*. The safflower affords a red dye, chiefly used for dyeing silks.

Some flowers close and open—"sleeping" and "awaking," as it has been fancifully called. Linnæus drew up a list of flowers, his "horologium floræ" (floral clock), from the various times at which flowers open and close during the twenty-four hours. This movement is due to differences in light and state of the weather. But as these vary in different latitudes, and even in the same place, a floral clock is at best but a rough guide. The gain experienced by the flowers may be in the protection of pollen from rain, in preventing the radiation of heat, or in excluding certain insects in favour of others which are more useful in cross-fertilization.

FLOWERS (as symbols and emblems) have served many uses in the world's history. The Spanish broom (*Spartium junceum*) has become famous as the *planta genista*, which gave a name to our Angevin sovereigns or Plantagenets. The rose is the flower of England, and gave its name to the Wars of the Roses, in which by mutual extermination the rival parties of nobles gave the Tudor tyranny the power to rear its head at the close of the fifteenth century. The white rose of York and the red rose of Lancaster gave way before the astutely designed party-coloured rose of the Tudor. The thistle of Scotland is a very ancient badge, dating, it is said, from the time when an invading party of Danes one night, stung by the prickly plant, revealed their presence by an involuntary cry, and the Scots had timely warning of the attack. The shamrock of Ireland and the leek of Wales are leaves, not flowers. The lily of Florence is the giglio of the Virgin Mary ("Santa Maria del Fiore," Saint Mary with the flower), and this is the title of the world-renowned Duomo. As with the roses in England, so in Florence the Guelphs (papalists) adopted the red lily and the Ghibellines (imperialists) chose the white lily as their badge. The arms of the town changed colour according to the supremacy of pope or emperor for the time being. Of other national flowers the lime is for Prussia, the mignonette for Saxony, the pomegranate for Spain, the violet for Athens. Then we have a later cult of the violet among the Napoleonist faction in France, and a like use of the primrose among the admirers of Lord Beaconsfield in England. Many flowers are associated with certain qualities as their symbols. The white lily symbolizes purity; the orange, virginity; the rose, incorruption; the holly-berries, resurrection, &c.

Artificial Flowers.—The petals of flowers are imitated by ribbons, feathers, silkworm cocoons, cambric, taffeta, jaconet, muslin, crape, satin, velvet, or thin laminæ of whalebone shaped and coloured for the purpose. The stems are mostly formed of wires, wrapped round with paper, silk, or some other material of the required colour. The leaves and petals are mostly cut, and, if needful, embossed by stamping with dies with sharp-cutting edges, and are united together by means of wires and paste or cement. The modes of colouring are exceedingly various. Seeds and similar objects, and small fruits, such as currants, are beautifully imitated by wax, glass, or other compositions. Very beautiful imitations of plants are made with wax, rice-paper, and shells.

Artificial flowers to the value of nearly £400,000 are annually imported into the United Kingdom, three-fourths of them being brought into France.

END OF VOL. V.

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